

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 1 of 34      |    |

**COPYRIGHT AND CONFIDENTIAL**  
 The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED**,  
 It must not be used directly or indirectly in any way detrimental to the interest of the company.

# **TECHNICAL SPECIFICATION** **FOR** **FIRE WATER PUMPS** **(Hydrant-Spray Water Pumps, Hydrant Booster** **Pumps, Spray Booster Pumps, Jockey Pumps)**

|                   |                                                                                |
|-------------------|--------------------------------------------------------------------------------|
| <b>PROJECT</b>    | <b>5X800 MW YADADRI THERMAL POWER STATION<br/>PROJECT, NALGONDA, TELANGANA</b> |
| <b>CUSTOMER</b>   | <b>TELANGANA STATE POWER GENERATION<br/>CORPORATION LTD. (TSGENCO)</b>         |
| <b>CONSULTANT</b> | <b>TATA CONSULTING ENGINEERS LTD.</b>                                          |

| Revisions:<br>Refer to record of<br>revisions | Prepared by :                                                                                       | Checked by :                                                                                              | Approved by :                                                                                                | Date :   |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------|
|                                               | <br>RATISH KUMAR | <br>GIRISH PRASAD PALO | <br>SURYA SATYA NAGESH M | 03.03.20 |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 2 of 34      |    |

## INDEX

| S. No. | DESCRIPTION                                |
|--------|--------------------------------------------|
| 1.0    | Intent of Specification                    |
| 2.0    | Special Instructions to Bidders            |
| 3.0    | Project Information                        |
| 4.0    | Application of System                      |
| 5.0    | Technical Details/Requirements             |
| 6.0    | Scope of Supply                            |
| 7.0    | Optional Prices                            |
| 8.0    | Void                                       |
| 9.0    | Quality Plan & Inspection Agency & Testing |
| 10.0   | Painting                                   |
| 11.0   | Packing and Forwarding                     |
| 12.0   | Sub Vendors                                |
| 13.0   | Documentation                              |
| 14.0   | Price Bid Format                           |
| 15.0   | Pre-Bid Clarifications                     |
| 16.0   | Variant table                              |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 3 of 34      |    |

#### LIST OF ENCLOSURES

|  |                                                                                                                                                                                                                                                                                                                 |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Annexure 1 – A: P&ID for Pump & Drive assembly<br>Annexure 1 – B: Layout (Typical)<br>Annexure 1 – C: Exhaust Piping layout                                                                                                                                                                                     |
|  | Annexure 2 - Pump-Motor-Engine datasheet<br>Annexure 2 –A: Hydrant-Spray Pump-Motor-Engine datasheet<br>Annexure 2 –B: Hydrant Booster Pump-Motor-Engine datasheet<br>Annexure 2 –C: Spray Booster Pump-Motor-Engine datasheet<br>Annexure 2 –D: Jockey Pump-Motor datasheet                                    |
|  | Annexure 3-Price bid Format<br>Annexure 3 –A: Hydrant-Spray Pump assembly Price bid Format<br>Annexure 3 –B: Hydrant Booster Pump assembly Price bid Format<br>Annexure 3 –C: Spray Booster Pump assembly Price bid Format<br>Annexure 3 –D: Jockey Pump-Motor assembly Price bid Format                        |
|  | Annexure 4- Checklist<br>Annexure 4 –A: Hydrant-Spray Pump assembly Checklist<br>Annexure 4 –B: Hydrant Booster Pump assembly Checklist<br>Annexure 4 –C: Spray Booster Pump assembly Checklist<br>Annexure 4 –D: Jockey Pump-Motor assembly Checklist                                                          |
|  | Annexure 5- Customer/Consultant specification<br>Annexure 5- A: Technical Specification For Fire Protection System<br>Annexure 5- B: Technical Specification For A.C. & D.C. Motors<br>Annexure 5- C: General Electrical Specification<br>Annexure 5- D: C&I Specification<br>Annexure 5- E: Misc Specification |
|  | Annexure 6-Void                                                                                                                                                                                                                                                                                                 |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 4 of 34      |    |

|  |                                                                                                                                                                                                                                                                                                                                                                              |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |                                                                                                                                                                                                                                                                                                                                                                              |
|  | <p>Annexure 7- QAP Guide Line &amp; Formats</p> <p>Annexure 7 –A: Hydrant-Spray Pump assembly QAP Guide Line &amp; Formats</p> <p>Annexure 7 –B: Hydrant Booster Pump assembly QAP Guide Line &amp; Formats</p> <p>Annexure 7 –C: Spray Booster Pump assembly QAP Guide Line &amp; Formats</p> <p>Annexure 7 –D: Jockey Pump-Motor assembly QAP Guide Line &amp; Formats</p> |
|  | Annexure 8- Sub-vendor List                                                                                                                                                                                                                                                                                                                                                  |
|  | <p>Annexure 9- Master DOC List Format</p> <p>Annexure 9 –A: Hydrant-Spray Pump assembly Master DOC List Format</p> <p>Annexure 9 –B: Hydrant Booster Pump assembly Master DOC List Format</p> <p>Annexure 9 –C: Spray Booster Pump assembly Master DOC List Format</p> <p>Annexure 9 –D: Jockey Pump-Motor assembly Master DOC List Format</p>                               |
|  | Annexure 10- Deviation Format                                                                                                                                                                                                                                                                                                                                                |
|  | Annexure 11- Pre-bid clarification format                                                                                                                                                                                                                                                                                                                                    |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 5 of 34      |    |

#### DOCUMENTS TO BE SUBMITTED WITH THE BID:

The bidder must submit the following documents along with their bid to enable BHEL to evaluate their offer.

- i. Duly filled in Pump-Motor-Diesel Engine datasheet (**Annexure-2A, 2B, 2C & 2D**)
- ii. Tentative GA Drawings for all variants Pump & Drive assembly
- iii. Performance curves for all variants Pump
- iv. T-S curve for main Hydrant-Spray Pumps
- v. Un-priced copy of price in attached BHEL price bid formats (**Annexure-3A, 3B, 3C & 3D**) indicating quoted/ not quoted against each row & column.
- vi. Checklist as per (**Annexure-4A, 4B, 4C & 4D**)
- vii. PQC with filled in annexure
- viii. Bidder shall submit **NO DEVIATION certificate** along with their offer. Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer.

**In case the above-mentioned documents are not submitted with the offer, the offer of the bidder may be liable for technical rejection.**

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 6 of 34      |    |

## 1. INTENT OF SPECIFICATION

This specification specifies the requirement of Design, Engineering, Manufacturing, Assembling, Inspection, Testing at manufacturer's works and Delivery of properly packed and painted **Fire water pumps [Hydrant-Spray, Hydrant Booster, Spray Booster and Jockey Pump assembly]** including drive assembly with all accessories as specified in the scope of work and as required for the safe and trouble-free operation of equipment to be installed at site.

## 2. SPECIAL NOTES TO BIDDERS

- 2.1 This specification shall be read in conjunction with its enclosures. In case of any discrepancy arising between this specification & its enclosures, the most stringent of all shall be followed and shall over-ride others. Further, if a requirement in this specification or its enclosures, calls for decision of owner/BHEL, it shall be bidder's sole responsibility to clearly bring out the same distinctively in his technical tender offer, so as to enable owner/BHEL to furnish their decision. If such a requirement is not duly addressed by bidder during tender stage and same comes out during order execution stage, it shall be binding on the bidder to comply with the decision furnished by owner/BHEL then, without any cost, delivery, or any other commercial implications.
- 2.2 Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.
- 2.3 The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipment's. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the Pump unit is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.
- 2.4 Bidder shall quote strictly as per the scope of supply and requirements of this specification.
- 2.5 Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.
- 2.6 In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid.
- 2.7 Incase Bidder is unable to offer due to any specific requirement of specification, Bidder shall bring out the same in their regret letter. Otherwise, it will be considered that non-participation by the bidder is attributable to reasons other than any specification requirements.



**PRODUCT STANDARD**  
**BHARAT HEAVY ELECTRICALS LIMITED**  
**PROJECT ENGINEERING & SYSTEMS DIVISION**

Std. / Doc. Number

**PY51464**

Rev. No.

00

Sheet 7 of 34

### 3. PROJECT INFORMATION

| Sl. No. | Owner                                                     | TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)         |
|---------|-----------------------------------------------------------|---------------------------------------------------------------------|
| 1.      | Project                                                   | 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA |
| 2.      | Owner's consultant                                        | TATA CONSULTING ENGINEERS LTD.                                      |
| 3.      | Location                                                  |                                                                     |
| 4.      | Airport                                                   | Vijayawada Airport- 140 km                                          |
| 5.      | Nearest Railway Station                                   | Guntur Jn Rail Way Station- 109 km                                  |
| 6.      | Maximum outside Ambient Air Temperature (deg. C)          | 50                                                                  |
| 7.      | Minimum outside Ambient Air Temperature (deg. C)          | 10                                                                  |
| 8.      | Elevation                                                 | 235 m                                                               |
| 9.      | Relative humidity                                         | 65 %                                                                |
| 10.     | Design Ambient for Electrical equipment / system (deg. C) | 50                                                                  |

**Note:** Any data required for designing the equipment, bidder may ask prior to the submission of bid.

### 4. APPLICATION OF SYSTEM

- a) 3 Nos of Electric motor driven and 2 No of Diesel Engine driven Hydrant Water Pump (Centrifugal, Horizontal type) is envisaged for supplying water to Hydrant header from the fire water storage sump.
- b) 2 Nos of Electric motor driven and 1 No of Diesel Engine driven Spray water Pump (Centrifugal, Horizontal type) are envisaged for supplying the water to the spray water system from the Fire water storage sump.
- c) 1 No of Electric motor driven and 1 No of Diesel Engine driven Hydrant Booster Pump is envisaged for circulating water from outlet of main Fire water Pump to Fire Protection System Elevated Structures (Such as Boiler, Towers etc.)
- d) 1 No of Electric motor driven and 1 No of Diesel Engine driven Spray Booster Pump is envisaged for circulating water from outlet of main Fire water Pump to Fire Protection System Elevated Structures (Such as Transfer Towers etc.)
- e) 2 Nos of Electric motor driven Jockey Pump (Centrifugal, Horizontal type) for Pressurization of Hydrant/Spray System by supplying water from Firewater storage sump.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 8 of 34      |    |

## 5. TECHNICAL DETAILS/REQUIREMENTS

### 5.1. Design Parameters of the Hydrant/Spray Pump

| Sl. No. | Description                                                 | Unit                   | Rated Condition                                                                           |
|---------|-------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------|
| 1       | Temperature of Fluid                                        | Deg. C                 | Ambient                                                                                   |
| 3       | Capacity of each pump                                       | m <sup>3</sup> /hr     | 410                                                                                       |
| 4       | Pump Differential Head(At Discharge Flange)                 | mWC                    | 115                                                                                       |
| 5       | Available Pressure at Center line of Suction nozzle of Pump | Kg/cm <sup>2</sup> (a) | 1.0<br>Maximum suction pressure available is 2 Kg/cm <sup>2</sup> (a)                     |
| 6       | NPSHA at pump suction flange                                | mlc                    | 10.0                                                                                      |
| 7       | Margin between NPSHA & NPSHR                                |                        | 1 m at rated condition & NPSHR shall be less than NPSHA up to end of the curve condition. |

### 5.2. Design Parameters of the Hydrant booster Pump

| Sl. No. | Description                                                 | Unit                   | Rated Condition                                                                                                                                                                                                                   |
|---------|-------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Temperature of Fluid                                        | Deg. C                 | Ambient                                                                                                                                                                                                                           |
| 3       | Capacity of each pump                                       | m <sup>3</sup> /hr     | 171                                                                                                                                                                                                                               |
| 4       | Pump Differential Head(At Discharge Flange)                 | mWC                    | 45                                                                                                                                                                                                                                |
| 5       | Available Pressure at Center line of Suction nozzle of Pump | Kg/cm <sup>2</sup> (a) | 16.5 kg/cm <sup>2</sup> (a) [max]*<br>*Indicative value, However Available pressure at center line of suction nozzle =Main Hydrant Pump Shut off head + maximum 5% Positive tolerance on shut off head + Maximum suction pressure |
| 6       | NPSHA at pump suction flange                                | mlc                    | 80 m to 120 m                                                                                                                                                                                                                     |
| 7       | Margin between NPSHA & NPSHR                                |                        | 1 m at rated condition & NPSHR shall be less than NPSHA up to end of the curve condition.                                                                                                                                         |



|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 9 of 34      |    |

### 5.3. Design Parameters of the Spray booster Pump

| Sl. No. | Description                                                 | Unit                   | Rated Condition                                                                                                                                                                                                                   |
|---------|-------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Temperature of Fluid                                        | Deg. C                 | Ambient                                                                                                                                                                                                                           |
| 3       | Capacity of each pump                                       | m <sup>3</sup> /hr     | 410                                                                                                                                                                                                                               |
| 4       | Pump Differential Head(At Discharge Flange)                 | mWC                    | 45                                                                                                                                                                                                                                |
| 5       | Available Pressure at Center line of Suction nozzle of Pump | Kg/cm <sup>2</sup> (a) | 16.5 kg/cm <sup>2</sup> (a) [max]*<br>*Indicative value, However Available pressure at center line of suction nozzle =Main Hydrant Pump Shut off head + maximum 5% Positive tolerance on shut off head + Maximum suction pressure |
| 6       | NPSHA at pump suction flange                                | mlc                    | 80 m to 120 m                                                                                                                                                                                                                     |
| 7       | Margin between NPSHA & NPSHR                                |                        | 1 m at rated condition & NPSHR shall be less than NPSHA up to end of the curve condition.                                                                                                                                         |

### 5.4. Design Parameters of the Jockey Pump

| Sl. No. | Description                                                 | Unit                   | Rated Condition                                                                           |
|---------|-------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------|
| 1       | Temperature of Fluid                                        | Deg. C                 | Ambient                                                                                   |
| 3       | Capacity of each pump                                       | m <sup>3</sup> /hr     | 40                                                                                        |
| 4       | Pump Differential Head(At Discharge Flange)                 | mWC                    | 120                                                                                       |
| 5       | Available Pressure at Center line of Suction nozzle of Pump | Kg/cm <sup>2</sup> (a) | 1.0                                                                                       |
| 6       | NPSHA at pump suction flange                                | mlc                    | 10.0                                                                                      |
| 7       | Margin between NPSHA & NPSHR                                |                        | 1 m at rated condition & NPSHR shall be less than NPSHA up to end of the curve condition. |

|                       |                                                                                   |                                                                                                                         |  |                              |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|------------------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number           |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>               |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.                     | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet <b>10</b> of <b>34</b> |    |

## 6. SCOPE OF SUPPLY

The scope of supply for this enquiry is as given below:

Please refer to the enclosed Annexure-1 for general clarity on scope of supply. The system shall be provided as per Annexure-1 taking into all requirements including for testing, painting, documentation, sub vendor list, equipment specifications etc., specified in this specification and enclosures.

### Quantity of Pump & Drive Assembly

- i. 5 Nos. of Hydrant Water Pump [3 No. of Motor Driven & 2 No. for Engine Driven]  
3 Nos of Motors are excluded from bidders scope of supply. All these 3 nos of motors shall be free issued to vendor and directly supplied to vendor works by BHEL for testing.
- ii. 3 Nos. of Spray Water Pump [2 No. of Motor Driven & 1 No. for Engine Driven]  
2 Nos of Motors are excluded from bidders scope. All these 2 nos of motors shall be free issued to vendor and directly supplied to vendor works by BHEL for testing.
- iii. 2 Nos. of Hydrant Booster Pump [1 No. of Motor Driven & 1 No. for Engine Driven]
- iv. 2 Nos. of Spray Booster Pump [1 No. of Motor Driven & 1 No. for Engine Driven]
- v. 2 Nos. of Jockey Pump [Motor Driven]

The scope of supply or each Pump & Motor/ Diesel Engine drive assembly is as given below:

### 6.1. Pump

Horizontal Centrifugal pump complete with all accessories as per specification. Performance requirement, Design and construction of the pump shall be guided by the TAC recommendations & as per enclosed annexures.

*Elevation of vent nozzle of pump from the bottom of the base plate shall not be more than 1600 mm.*

### 6.2. Drives for pumps [Motor/Diesel Engine]

#### 6.2.1. Motor

**HT Motor:** [Applicable for main Hydrant-Spray Pumps]

5 Nos of HT Motors (for 3 Nos Hydrant pump & 2 No. Spray pump) are excluded from bidders scope of supply. These motors shall be free issued to vendor and directly supplied to vendor works by BHEL for testing.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 11 of 34     |    |

**However, bidder shall consider canopy with legs and other fixing accessories.**

**Further, suitable common base frame for pump and motor assembly shall be provided by bidder for mounting the HT motor at site. Cable Glands, & Lugs of HT Motors are included from bidder scope of supply. Cable size shall be informed in detailed engg stage.**

**Note:** Bidder to recommend suitable motor rating duly meeting the following (at 50 degree C ambient) and same shall be higher of the following two conditions:

- i. 110% of the duty point power requirement.
- ii. Motor input power required at end of curve

**LT Motor:** [Applicable for Jockey and Hydrant Booster & Spray Booster Pumps]

Suitable drive motor complete with terminal box, canopy, space heater, cable glands and lugs, earthing lugs and all other accessories required shall be provided for motor driven Hydrant booster, Spray Booster and Jockey Pump.

Continuous duty LT motors (rated at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30

Performance requirement, Design and construction of the Motor shall be guided by the TAC recommendations & as per enclosed annexures.

## **6.2.2. Diesel Engine**

### **6.2.2.1. Performance**

Performance requirement, Design and construction of the diesel engine shall be guided by the TAC recommendations and as per enclosed annexures.

- i. The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.
- ii. Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:
  - a. 3% for each 305 meter elevation above MSL
  - b. 1% for each 5.6° C rise in air temperature above 15.6° C
- iii. The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 12 of 34     |    |

#### 6.2.2.2. Diesel Engine Control Panel

PLC based Diesel Engine Control panel meeting to the requirements of TAC for each engine shall be included in bidder scope of supply. Panel shall be operated on DC Supply, suitably converted by dedicated rectifier bank, redundant transformers from mains A.C supply (230 V). Further, Battery backup shall also be provided along with auto-change over from normal to Battery supply in case of non-availability of Mains supply. 6 Nos [1 first time and 5 Repeat starts] of Kick Starts of Diesel Engine shall be envisaged in the panel.

The Control panel shall be Stand mounted. Bidder to provide suitable stand and all fixing accessories for mounting control panel.

Bidder to submit Soft copy and hard copy of logics executed in PLC for uploading the same by end customer later.

Starting power shall be supplied from two (2) sets of storage batteries. One (1) set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch shall be provided at the automatic starting control panel to select any of the two (2) sets of battery for manual/auto starting of the engine.

The automatic starting arrangement shall include, as a safeguard, a "Repeat Start" feature so that if the pinion of the starting motor does not engage the flywheel at the first attempt, it is automatically retracted and after a short pause again will advance towards the flywheel.

This repeat start cycle will continue until five (5) kicks after which there will be suitable annunciation.

Arrangement for both trickle and booster charge of the batteries shall be provided. When the engine starts running, provision should be kept to ensure that the charger is automatically disconnected and the battery is charged by engine dynamo.

Each diesel engine shall be provided with two (2) battery charger units of air cooled design. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilized for charging any one of the two (2) batteries of that engine.

All cabling [control/signal/power] from engine to control panel, panel to battery and engine to battery selector switch shall be in bidder scope of supply. Control panel, battery charger and battery selector switch is located within 5 m radius of pump skid. Pls refer annexure-1 for layouts for calculation of cable BOQ. Final Pump house layout shall be provided during detail engineering stage. Accordingly, bidder to consider suitable margin on required cabling based on their experience. Bidder to furnish cable BOQ, electrical load list, cable schedule and cable interconnection diagram.

Technical details of local control panel are indicated in **Annexure-4**.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 13 of 34     |    |

### 6.2.2.3. Diesel Engine Fuel Tank

Fuel oil tank having storage capacity sufficient to run the engine at full load for at least six (6) hours, Level transmitter and Level Gauge and required piping [5 m length minimum] & valves [from tank to engine and engine to tank] for engine (as per Annexure-1) shall be included in bidder scope. Valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. Pipe joints shall not be soldered and plastic tubing shall not be used.

Tanks shall be securely mounted on noncombustible supports. Accordingly, bidder to supply Fuel Tank mounting structure, all fixing accessories. Bidder to ensure sufficient leg height for flow of fuel from tank to Engine up to minimum level of fuel and ensuring engine manufacturer's fuel pump static head pressure limits not be exceeded when the level of fuel in the tank is at a maximum.

### 6.2.2.4. Diesel Engine Fuel Pump

1 No. of suitable 1 phase 230 Volt fuel pump (portable) with ex-proof motor to be supplied to fill up diesel oil from Diesel Drum received from supplier of Diesel.

1 No. of hand operated pump shall be supplied to fill up diesel oil from diesel drum received from supplier of diesel.

Necessary tubing [5m length] from Diesel Engine fuel pump to the fuel tank along with valve (If any) to be supplied by Bidder.

### 6.2.2.5. Instrumentation & Control

The diesel engine shall be provided with adequate instrumentation. These shall include but not limited to the following:

- i. Temperature indicator (contact type) in cooling water inlet and outlet.
- ii. Temperature indicator in lubricating oil outlet from the oil cooler.
- iii. Pressure gauges (contact type) for lubricating oil system.
- iv. Differential pressure gauges (contact type) across strainers/ filters.
- v. Speed indicator.
- vi. Running hour meter.
- vii. Dip. Stick type lubricating oil sump level indicator.
- viii. Gauge glass type Fuel Oil Tank level indicator.
- ix. Voltmeter & Ammeter in dynamo type battery-charging circuit.

Instrument hook-up materials (root valves, connectors, elbow and etc.) for the instruments supplied by bidder shall be in bidder scope of supply.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 14 of 34     |    |

#### 6.2.2.6. Diesel Engine Exhaust System

Bidder to consider 15 m of exhaust piping with silencer, SS metal expansion below & insulation with 6 Nos. of bends. The exhaust piping shall consist of bends, hood, bird screen etc. [For Additional Details please refer Annexure-1, preliminary layout]. Final layout shall be furnished during detailed engg stage.

#### 6.2.2.7. Battery & Battery Charger

- i. Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (or 2x12V) Automotive type battery with charger for each diesel engine driven fire water pumps primarily for starting the engine and control power supply to local control panel.
- ii. Each engine shall be provided with 2 Nos. Lead-acid plante battery units as per IS. Battery shall be sized to Cater for the following without any charging in between
  - a. Crank the engine twelve times (12) consecutive starts [each for a duration of 10 sec.] without recharging with a cold engine under full compression,
  - b. Control panel stand by load requirements for 72 hours.
- iii. Arrangement for both trickle and booster charge of the batteries shall be provided. When the engine starts running, provision should be kept to ensure that the charger is automatically disconnected and the battery is charged by engine dynamo.
- iv. Each diesel engine shall be provided with two (2) battery charger units of air cooled design. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilised for charging any one of the two (2) batteries of that engine.
- v. Storage batteries shall be rack supported above the floor, secured against displacement, and located where they will not be subject to excessive temperature, vibration, mechanical injury, or flooding with water. Accordingly, bidder to provide suitable stand/structure for mounting the battery.

All other details shall be as per TAC guidelines.

#### 6.3. Coupling Between Pump and Drives [motor/engine]

Coupling between pump and motor/engine shall comply with the following:

- i. Coupling shall be as per as per manufacturer's standard
- ii. Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer [The spacer length shall permit removal of the coupling, bearings, seal and rotor, as applicable, without disturbing the driver or the suction and discharge piping].

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 15 of 34     |    |

- iii. All coupling models shall be selected for a minimum service factor of 1.5 over driver rating.
- iv. Removable coupling guard shall be provided which shall be fabricated from non-sparking material, and shall be open at the bottom to permit manual shaft rotation.
- v. DBSE shall be more than the seal cartridge length.

#### 6.4. Base Frame

Common base frame with fixing bolts for each Pump & its drives. The Pumping set(s) shall be securely mounted on a robust bedplate and shall be free from vibration at all variations of load.

#### 6.5. Mechanical Seal

Mechanical seal as per manufacturer's standard.

#### 6.6. Interconnecting Piping & Instrumentation

Interconnecting piping and instrumentation as per P&I D [Annexure-1]

Reducer/expander, Flanges & Counter flanges with necessary gaskets & bolts at all terminal points as per annexure-1. Suction Reducer/expander shall be eccentric type. All counter flanges shall be of weld neck type.

**Pipes:** M. S. ERW pipes as per IS-1239, Part – 1 heavy grade (for pipes of sizes 150 mm NB or below) and IS-3589 Gr.410 ERW ( for sizes 200 mm NB and above) or equivalent and galvanized as per IS 4736 for pipes normally empty and periodically charged with water and foam system application.

**Flanges:** ASTM A234 Gr. WPB or ASTM A105 or equivalent.

**Fittings:** The material shall conform to ASTM A234 Gr. WPB or ASTM A105 or equivalent and dimensional standard conforming to ANSI B 16.9 (socket & threaded type), ANSI B 16.22 (for flanges and flanged fittings). Fabricated fittings shall not be acceptable up to pipe size of 300 NB. For sizes 350 NB & above, fittings may be fabricated as per BS: 2633/BS: 534.

The fittings shall be galvanized as per IS 4736 for galvanized pipe application

#### 6.7. Necessary Foundation Bolts, Nuts, Shims/Grouting Pads Etc.

#### 6.8. Supply of Accessories and Services

Following accessories shall be included in bidder scope:

- i. Base Plate
- ii. Foundation bolts, nuts, sleeves etc.
- iii. Suction & Discharge companion flanges with bolts, nuts & gaskets

|                       |                                                                                   |                                                                                                                         |  |                              |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|------------------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number           |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>               |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.                     | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet <b>16</b> of <b>34</b> |    |

- iv. Priming connection with 3 way SS isolating valve
- v. Vent with 3 way SS isolating valve
- vi. Pump-motor coupling and guard
- vii. Drain connection with valve
- viii. Eyebolts, lifting tackle etc.
- ix. Canopy with legs for Motors

#### **6.9. Provision For Vibration Probes**

Only provision for mounting probes & for mounting key phasor along with slot shall be made available on Pumps & Drives.

#### **6.10. BEARING & WINDING INSTRUMENTS & JB FOR PUMPS & DRIVES**

##### **6.10.1. For Main Hydrant & Spray Pumps (HT motor driven)**

- 1) 1 No. Duplex platinum resistance type RTD & 1 no of TG for Pump DE
- 2) 1 No. Duplex platinum resistance type RTD & 1 no of TG for Pump NDE

##### **6.10.2. For Hydrant Booster & Spray Booster & Jockey Pumps**

Bearing & Winding RTDs, JB's for Pump & Drive assembly are not required.

##### **6.10.3. Junction Box**

For main Hydrant & Spray Pump Bearing Instruments: 1 No. JB/Pump

#### **6.11. Complete Unit Test:**

##### **1) Motor driven pump:**

All pumps (Hydrant/Spray Pump, Hydrant Booster, Spray Booster and Jockey Pump) shall be tested by Job motor, Job coupling, and Job base plate etc.

It may be noted that, since HT motors for main Hydrant & Spray pumps are exclude from bidder scope of supply, motor shall be free issued to vendor from BHEL for testing at bidder works.

##### **2) Engine driven pump:**

All pumps (Hydrant/Spray Pump, Hydrant Booster and Spray Booster Pump) performance test shall be done with Job engine, Job coupling, and Job base plate etc. Power Vs Flow need not to be drawn considering the limitation of estimating the power absorbed.



|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 17 of 34     |    |

#### 6.12. First Fill of Lubricant

Excluded from bidder scope of supply. However LO schedule shall be furnished by Bidder.

#### 6.13. All Other Items Necessary for Safe And Smooth Running of Pump & Accessories Required to Make The Supplied Equipment Complete in All Respect.

#### 6.14. Commissioning Spares

##### 6.14.1. For Hydrant - Spray Pump & Drives Assembly:

8 sets (One set for each pump & drive assembly) of commissioning spares for Hydrant Pump with drive assembly shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum 1 Set of O rings & gaskets for each Pump.

One set stands for requirement for one no. of pump & drive assembly. Bidder to furnish the list along with the offer.

**Note:** Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor.

Commissioning spares required for HT Motors are excluded from bidder's scope of supply.

##### 6.14.2. For Hydrant Booster Pump & Drives Assembly:

2 sets (One set for each pump & drive assembly) of commissioning spares for Hydrant Booster Pump with drive assembly shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum 1 Set of O rings & gaskets for each Pump & 1 Set of Commissioning Spares for Drive as per Manufacturer recommendation.

1 set stands for requirement for one no. of pump & drive assembly. Bidder to furnish the list along with the offer.

**Note:** Any commissioning spare required over and above the recommended commissioning spares commissioning shall be supplied free of cost by the equipment vendor.

##### 6.14.3. For Spray Booster Pump & Drives Assembly:

2 sets (One set for each pump & drive assembly) of commissioning spares for Spray Booster Pump with drive assembly shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum 1 Set of O rings & gaskets for each Pump & 1 Set of Commissioning Spares for Drive as per Manufacturer recommendation.

1 set stands for requirement for one no. of pump & drive assembly. Bidder to furnish the list along with the offer.

**Note:** Any commissioning spare required over and above the recommended commissioning spares commissioning shall be supplied free of cost by the equipment vendor.



#### 6.14.4. For Jockey Pump & Motor Assembly:

2 Set (One set for each pump & motor assembly) of commissioning spares for Jockey Pump with Motor shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum 1 Set of O rings & gaskets for each Pump & 1 Set of Commissioning Spares for Drive as per Manufacturer recommendation.

One set stands for requirement for one no. of pump & drive assembly. Bidder to furnish the list along with the offer.

**Note:** Any commissioning spare required over and above the recommended commissioning spares commissioning shall be supplied free of cost by the equipment vendor.

#### 6.15. Mandatory Spares:

##### 6.15.1. For Hydrant - Spray Pump with drive assembly

##### 1) For Hydrant - Spray Pump-Pump

| Description            | Quantity |
|------------------------|----------|
| a) Set of Impellers    | 2 sets   |
| b) Set of Shafts       | 2 sets   |
| c) Casing wear rings   | 2 sets   |
| d) Impeller wear rings | 2 sets   |
| e) Shaft sleeves       | 2 sets   |
| f) Shaft Coupling      | 2 sets   |
| g) Shaft nut & key     | 2 sets   |
| h) Bearing             | 2 sets   |

##### 2) For Hydrant - Spray pump - Motor: Not in bidder scope of supply

##### 3) For Hydrant - Spray pump - Engine

| Description                      | Quantity |
|----------------------------------|----------|
| a) Element for lub oil Filter    | 4 Nos    |
| b) Element for Fuel Filter       | 4 Nos    |
| c) Outer Element for Air cleaner | 4 Nos    |
| d) Inner Element for Air cleaner | 4 Nos    |
| e) Turbo-charger                 | 2 Nos    |
| f) Engine - starter Motor        | 2 Nos    |
| g) Injector                      | 4 Nos    |
| h) Piston rings & liner set      | 4 Sets   |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 19 of 34     |    |

#### 4) For Hydrant - Spray pump – Panel

| Description                                      | Quantity                                            |
|--------------------------------------------------|-----------------------------------------------------|
| a) Push Button-Complete assembly                 | 10 Nos per each color                               |
| b) Push Button-Contact Element (1NO + 1NC) Block | 40 Nos                                              |
| c) Selector Switch [each type and rating]        | 20 Nos                                              |
| d) Voltmeter [each type & Rating]                | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| e) Ammeter [each type & Rating]                  | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| f) Frequency Meter [each type & Rating]          | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| g) Indicating Lamps complete assembly            | 20 Nos per each color and type                      |

#### 5) For Hydrant - Spray pump – Instrumentation

| Description                                                           | Quantity                                                                                   |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| a) Transmitters/ Gauges/Switches etc. along with relevant accessories | Total Installed qty x 10 % x (2/5) or minimum 2 nos) for each type along with accessories. |
| b) Temperature Element (RTD/Thermocouple) with thermowell             | Total Installed qty x 10 % x (2/5) or minimum 5 nos                                        |
| c) Cables (Control & Instrumentation)                                 | Total Installed qty x 10 % x (2/5)                                                         |

### 6.15.2. For Hydrant Booster Pump with drive assembly

#### 1) For Hydrant Booster Pump-Pump

| Description            | Quantity |
|------------------------|----------|
| a) Set of Impellers    | 2 sets   |
| b) Set of Shafts       | 2 sets   |
| c) Casing wear rings   | 2 sets   |
| d) Impeller wear rings | 2 sets   |
| e) Shaft sleeves       | 2 sets   |
| f) Shaft Coupling      | 2 sets   |
| g) Shaft nut & key     | 2 sets   |
| h) Bearing             | 2 sets   |



## 2) For Hydrant Booster pump - Motor

Above 30 kW Rating

| Description                                   | Quantity                                 |
|-----------------------------------------------|------------------------------------------|
| a) End Shield Cover Driving & Non-Driving End | 2 Sets for each type and rating of Motor |
| b) Driving End & Non-Driving End Bearing      | 2 Sets for each type and rating of Motor |
| c) Cooling Fan                                | 2 Nos. for each type and rating of Motor |
| d) Motor Space Heater                         | 2 Nos. for each type and rating of Motor |
| e) Motor Terminal Block                       | 2 Nos. for each type and rating of Motor |
| f) Complete Set of Coupling                   | 2 Sets for each Application              |

Up to 30 kW Rating

| Description                              | Quantity                                 |
|------------------------------------------|------------------------------------------|
| a) Driving End & Non-Driving End Bearing | 6 Sets for each type and rating of Motor |
| b) Cooling Fan                           | 4 Nos for each type and rating of Motor  |
| c) Motor Terminal Block                  | 10 Nos for each type and rating of Motor |
| d) Complete Set of Coupling              | 2 Sets for each Application              |

## 3) For Hydrant Booster - Engine

| Description                      | Quantity |
|----------------------------------|----------|
| a) Element for lub oil Filter    | 4 Nos    |
| b) Element for Fuel Filter       | 4 Nos    |
| c) Outer Element for Air cleaner | 4 Nos    |
| d) Inner Element for Air cleaner | 4 Nos    |
| e) Turbo-charger                 | 2 Nos    |
| f) Engine - starter Motor        | 2 Nos    |
| g) Injector                      | 4 Nos    |
| h) Piston rings & liner set      | 4 Sets   |

## 4) For Hydrant Booster pump – Panel

| Description                                      | Quantity                                            |
|--------------------------------------------------|-----------------------------------------------------|
| a) Push Button-Complete assembly                 | 10 Nos per each color                               |
| b) Push Button-Contact Element (1NO + 1NC) Block | 40 Nos                                              |
| c) Selector Switch [each type and rating]        | 20 Nos                                              |
| d) Voltmeter [each type & Rating]                | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| e) Ammeter [each type & Rating]                  | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| f) Frequency Meter [each type & Rating]          | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| g) Indicating Lamps complete assembly            | 20 Nos per each color and type                      |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 21 of 34     |    |

### 5) For Hydrant Booster pump – Instrumentation

| Description                                                           | Quantity                                                                                   |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| a) Transmitters/ Gauges/Switches etc. along with relevant accessories | Total Installed qty x 10 % x (2/5) or minimum 2 nos) for each type along with accessories. |
| b) Temperature Element (RTD/Thermo-couple) with thermowell            | Total Installed qty x 10 % x (2/5) or minimum 5 nos                                        |
| c) Cables (Control & Instrumentation)                                 | Total Installed qty x 10 % x (2/5)                                                         |

### 6.15.3. For Spray Booster Pump with drive assembly

#### 1) For Spray Booster Pump-Pump

| Description            | Quantity |
|------------------------|----------|
| a) Set of Impellers    | 2 sets   |
| b) Set of Shafts       | 2 sets   |
| c) Casing wear rings   | 2 sets   |
| d) Impeller wear rings | 2 sets   |
| e) Shaft sleeves       | 2 sets   |
| f) Shaft Coupling      | 2 sets   |
| g) Shaft nut & key     | 2 sets   |
| h) Bearing             | 2 sets   |

#### 2) For Spray Booster pump - Motor

Above 30 kW Rating

| Description                                   | Quantity                                 |
|-----------------------------------------------|------------------------------------------|
| a) End Shield Cover Driving & Non-Driving End | 2 Sets for each type and rating of Motor |
| b) Driving End & Non-Driving End Bearing      | 2 Sets for each type and rating of Motor |
| c) Cooling Fan                                | 2 Nos. for each type and rating of Motor |
| d) Motor Space Heater                         | 2 Nos. for each type and rating of Motor |
| e) Motor Terminal Block                       | 2 Nos. for each type and rating of Motor |
| f) Complete Set of Coupling                   | 2 Sets for each Application              |

Up to 30 kW Rating

| Description                              | Quantity                                 |
|------------------------------------------|------------------------------------------|
| a) Driving End & Non-Driving End Bearing | 6 Sets for each type and rating of Motor |
| b) Cooling Fan                           | 4 Nos for each type and rating of Motor  |
| c) Motor Terminal Block                  | 10 Nos for each type and rating of Motor |
| d) Complete Set of Coupling              | 2 Sets for each Application              |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 22 of 34     |    |

### 3) For Spray Booster - Engine

| Description                      | Quantity |
|----------------------------------|----------|
| a) Element for lub oil Filter    | 4 Nos    |
| b) Element for Fuel Filter       | 4 Nos    |
| c) Outer Element for Air cleaner | 4 Nos    |
| d) Inner Element for Air cleaner | 4 Nos    |
| e) Turbo-charger                 | 2 Nos    |
| f) Engine - starter Motor        | 2 Nos    |
| g) Injector                      | 4 Nos    |
| h) Piston rings & liner set      | 4 Sets   |

### 4) For Spray Booster pump – Panel

| Description                                      | Quantity                                            |
|--------------------------------------------------|-----------------------------------------------------|
| a) Push Button-Complete assembly                 | 10 Nos per each color                               |
| b) Push Button-Contact Element (1NO + 1NC) Block | 40 Nos                                              |
| c) Selector Switch [each type and rating]        | 20 Nos                                              |
| d) Voltmeter [each type & Rating]                | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| e) Ammeter [each type & Rating]                  | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| f) Frequency Meter [each type & Rating]          | Total Installed qty x 10 % x (2/5) or minimum 2 nos |
| g) Indicating Lamps complete assembly            | 20 Nos per each color and type                      |

### 5) For Spray Booster pump – Instrumentation

| Description                                                           | Quantity                                                                                   |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| a) Transmitters/ Gauges/Switches etc. along with relevant accessories | Total Installed qty x 10 % x (2/5) or minimum 2 nos) for each type along with accessories. |
| b) Temperature Element (RTD/Thermo-couple) with thermowell            | Total Installed qty x 10 % x (2/5) or minimum 5 nos                                        |
| c) Cables (Control & Instrumentation)                                 | Total Installed qty x 10 % x (2/5)                                                         |

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 23 of 34     |    |

#### 6.15.4. For Jockey Pump with drive assembly

##### 1) For Jockey Pump-Pump

| Description            | Quantity |
|------------------------|----------|
| a) Set of Impellers    | 2 sets   |
| b) Set of Shafts       | 2 sets   |
| c) Casing wear rings   | 2 sets   |
| d) Impeller wear rings | 2 sets   |
| e) Shaft sleeves       | 2 sets   |
| f) Shaft Coupling      | 2 sets   |
| g) Shaft nut & key     | 2 sets   |
| h) Bearing             | 2 sets   |

##### 2) For Jockey pump - Motor

Above 30 kW Rating

| Description                                   | Quantity                                 |
|-----------------------------------------------|------------------------------------------|
| a) End Shield Cover Driving & Non-Driving End | 2 Sets for each type and rating of Motor |
| b) Driving End & Non-Driving End Bearing      | 2 Sets for each type and rating of Motor |
| c) Cooling Fan                                | 2 Nos. for each type and rating of Motor |
| d) Motor Space Heater                         | 2 Nos. for each type and rating of Motor |
| e) Motor Terminal Block                       | 2 Nos. for each type and rating of Motor |
| f) Complete Set of Coupling                   | 2 Sets for each Application              |

Up to 30 kW Rating

| Description                              | Quantity                                 |
|------------------------------------------|------------------------------------------|
| a) Driving End & Non-Driving End Bearing | 6 Sets for each type and rating of Motor |
| b) Cooling Fan                           | 4 Nos for each type and rating of Motor  |
| c) Motor Terminal Block                  | 10 Nos for each type and rating of Motor |
| d) Complete Set of Coupling              | 2 Sets for each Application              |

#### Special notes for Mandatory spares:

- The word "set" means the quantity required for full replacement of that part in one machine.
- The word "TYPE" means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
- Wherever % age is identified, bidder shall supply next rounded figure.
- Part Description is the commonly used name of the part and may vary from manufacturer to manufacturer.
- Mandatory spares as indicated above do not cover commissioning spares.
- Mandatory spares as indicated above do not cover two year O&M spares.
- All Mandatory spares should be supplied separately with green color painted box.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 24 of 34     |    |

- viii. Loose items sent by Vendor to sites shall be quantified/numbered/tagged and not merely mentioned as ONE lot of loose items.
- ix. A packing list covering items having shelf life are to be intimated to site. In addition, shelf life items shall be packed separately in black color painted box for easy identification at site.
- x. Spare rotors shall be boxed in a metal containers for vertical storage with nitrogen purging. Storage container shall be property of the owner.

#### **6.16. Auxiliaries Equipment's/Spares**

Bidder to include all auxiliary equipment [clause no 7.4.5.7.3 of TAC] & spares [7.4.5.11 of TAC] as per TAC in addition to above mandatory spares.

#### **6.17. Special Tools And Tackles**

##### **6.17.1. For Hydrant - Spray pump with drives:**

The bidder shall furnish a complete 8 sets [1 set each for Pumps with Drive assembly] of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance [disassemble, assemble, or maintaining the unit] of the Hydrant and Spray Pump supplied, as a part of scope of supply. Bidder shall furnish a list of such tools along with offer for the system. Prices for the special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.

Special Tools and tackles required for HT Motors (for Hydrant and Spray Pump) are excluded From bidder scope of supply.

##### **6.17.2. For Hydrant Booster pump with drives:**

The bidder shall furnish a complete 2 sets [1 set each for Pumps with Drive Motors & Pumps with Diesel Engines] of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance [disassemble, assemble, or maintaining the unit] of the Hydrant Booster water Pump supplied, as a part of scope of supply. Bidder shall furnish a list of such tools along with offer for the system. Prices for the special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.

##### **6.17.3. For Spray Booster pump with drives:**

The bidder shall furnish a complete 2 sets [1 set each for Pumps with Drive Motors & Pumps with Diesel Engines] of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance [disassemble, assemble, or maintaining the unit] of the Spray Booster water Pump supplied, as a part of scope of supply. Bidder shall furnish a list of such tools along with offer for the system. Prices for the special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.



|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 25 of 34     |    |

#### 6.17.4. For Jockey pump with drives:

The bidder shall furnish a complete 2 sets [1 set each for Pump with drive assembly] of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance [disassemble, assemble, or maintaining the unit] of the Jockey Pump supplied, as a part of scope of supply. Bidder shall furnish a list of such tools along with offer for the system. Prices for the special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.

#### 6.17.5. Supervision of Erection & Commissioning:

Supervision of erection, commissioning of the supplied system shall be included in bidder's scope of service.

Bidder to note that the supervision charges for erection & commissioning shall consists of the following:

- Per day supervision charges of an Engineer including all other expenses like boarding, lodging, local travel, insurance etc.
- Travel expenses (inclusive of any clearance charges like Visa fee etc, insurance) from to vendor works to site.

Per diem charges shall be applicable from the day bidder's representative reports to site, up to the day certified by BHEL's site.

For the purpose of tender following to be considered: [for details pl. refer price bid formats].

#### Notes:

- i. However, either or both of the number of man days or number of visits may change on either side based on the actual site requirement.
- ii. All payments towards supervision of E&C shall be made only after BHEL-site certification.
- iii. Bidder to mobilize concerned competent person for supervision of Erection & commissioning activities within a period of 7 days of receipt of intimation in this regard by BHEL.
- iv. Bidder to quote supervision of erection and commissioning activities strictly as per BHEL's price format

#### 6.17.6. Conflicts in Specification Requirement:

In case of any conflict between this specification and Annexures stringent of the requirement will govern.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 26 of 34     |    |

## 7. OPTIONAL PRICES

Please Refer to Attached Price Bid Format. Bidder to furnish the following as optional prices:

Bidder to furnish optional prices for 2 year recommended spares as per equipment manufacturer's recommendations. [The Bidder shall quote separately with optional price for the recommended list of spare parts for operation, with recommended quantities for the equipment covered under this specification. Bidder shall furnish such a list along with offer. The list of spares shall be as per Bidder's experience.]

## 8. Void

## 9. QUALITY PLAN & INSPECTION AGENCY & TESTING

For details, pl refer annexure-4&7.

### 9.1. Quality Plan

Quality plan will be reviewed during detailed Engineering stage with respect to Inspection, standard Engineering practices & Specification Requirements and various tests and stages of inspection and appropriate agencies for Inspection will be Intimated. Bidder to abide by the same.

For guidelines & format: Refer **Annexure-7**.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 27 of 34     |    |

## 9.2. Inspection Agency

BHEL/Third Party appointed by BHEL/Customer.

The various review/witness/observation stages by individual agencies (or) Group of Agencies as above will be in line with approved quality plan. Also refer Annexure-07.

## 9.3. Testing

The design and Testing Standards of the Pumps shall conform to the standards as indicated in the TAC recommendation.

However, Performance tolerance shall be as mentioned below:

- i. Rated head at rated flow: Zero negative tolerance
- ii. Shut-off head: Zero negative tolerance. Maximum 5% Positive tolerance permitted.
- iii. Permissible tolerance in efficiency at rated capacity: No negative tolerance
- iv. Rated BkW: Zero positive tolerance. Positive tolerance permitted till motor rating meets end of the curve condition.
- v. Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span End of curve including 150% of rated capacity up to pump shut-off condition.

## 10. PAINTING

Painting for Pump, Motor, Engine and all other accessories shall be as per annexure -4.

**Final shade for Pump, Motor and Engine shall be informed during detail engineering stage.**

## 11. PACKING AND FORWARDING

Bidder to note that Packing and Forwarding shall be as per manufacturing standard meeting the requirement is acceptable. Packing shall be suitable for outdoor storage: More than 6 months. For details Pl. refer Annexure -4.

## 12. SUB VENDORS

HT Motors: BHEL-Bhopal [Free issue to vendor at vendor works]

Bidder shall follow sub vendors list enclosed as Annexure-8. In case of any specific practical difficulty, bidder is requested to bring out the same with proper reason for not following vendor list. For other items for which sub vendors are not specified, bidder can follow their standard vendors. However, they have to ensure the Proven Track record of the sub vendors and Bidder to take prior approval of BHEL for the same.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 28 of 34     |    |

### 13. DOCUMENTATIONS

Please refer to enclosed Master Documentation List [MDL] for the list of DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation. Bidder shall ensure submission of all documentation as per the MDL, Annexure: 9.

Bidder to note that the dates of submission of all the documents shall be finalized based on PO date. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule.

#### **DEFINITION OF VENDOR DOCUMENT REVIEW STATUS ASSIGNED BY BHEL**

The guidelines listed below are followed in assigning the document status code to the vendor documents: Final submittal of vendor documents will not be required as long as the document status code is 1 or 4 and the "AS-BUILT" condition of the component agrees with the current document.

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the vendor and does not relieve the vendor from full compliance with contractual obligations.

#### **Code-1: Work may proceed**

The document conforms to procurement document requirements. The document requires no changes or additions. Matters remaining to be resolved do not require document change and will be handled by correspondence. Where it is known that the design information on a vendor document is not complete and re-submittals will be required, e.g., due to "hold" areas, the document is assigned another status code.

#### **Code-2: Revise and resubmit**

Work may proceed subject to resolution of indicated comments. The document is in basic conformance with procurement document requirements. Minor deviations from procurement document requirements have been noted or other minor technical or physical changes in the equipment are required. The vendor shall resolve comments and resubmit documents prior to shipment of commodity.

#### **Code-3: Rejected. Revise and resubmit**

The document:

- Does not conform to the procurement requirements,
- Is of a design that is technically unacceptable without significant changes,
- Does not meet project requirements, i.e., orientation of equipment, nozzles, conduit connections, etc.,
- Does not conform to project criteria or with proposal documents or data, or
- Does not meet minimum submittal requirements.

This submittal rejection does not relieve vendor of any schedule commitments.

#### **Code-4: Review not required**

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 29 of 34     |    |

The document is not subject to BHEL review. Typical uses for this status are in the review of items that are vendor standard products, small internal parts of major equipment, or vendor standardized data.

#### **DRAWINGS REVIEW & APPROVALS:**

Each drawing submitted by the bidder shall be with a title block furnished by BHEL during detailed engg stage.

All drawings / documents shall be thoroughly checked, duly signed, and stamped by the vendor including drawing /documents of sub-vendor, before submission to BHEL. Documents, which are unchecked, unsigned, and without revisions marked clearly, shall be returned without review. Any delay on account of this shall be to the vendor's account. After first review of documents, vendor to submit all the further revisions of documents along with comment resolution sheet. Successive documents submitted without comment resolution sheet shall be returned without review.

The approval and /or review by BHEL /End customer shall not be construed by the bidder as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

Documents once reviewed in Code-1 shall not be submitted (incorporating some changes) again for review, however if some change is really necessary, the same shall be brought to the notice of BHEL separately through design change note for review / information. Finally, As-built drawings, duly updated, shall be submitted.

During detailed engg stage, BHEL shall furnish detailed format for datasheet of Pump, Motor, Engine and check list reg minimum contents in GA drawing. Bidder to submit duly filled in respective datasheets for Pump, Motor, Engine and submit GAD [duly incorporating all requirements as per the check list] along with signed checklist. GAD shall not be reviewed without duly filled in checklist signed by the bidder.

#### **NO. OF COPIES OF EACH DOCUMENT TO BE FURNISHED:**

All the documents shall be submitted as given below:

| SL NO. | DESCRIPTION                                                 | NO. OF COPIES / PIECES TO BE SUBMITTED | WHEN TO SUBMIT                        |
|--------|-------------------------------------------------------------|----------------------------------------|---------------------------------------|
| 1)     | Initial drawings/documents under approval and information   | Soft copy only                         | Within 2 weeks of placement of order  |
| 2)     | BHEL shall furnish their observation on submitted documents | Soft copy only                         | Within 2 weeks of document submission |

|                       |                                                                                   |                                                                                                                         |  |                              |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|------------------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number           |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>               |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.                     | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet <b>30</b> of <b>34</b> |    |

|    |                                                                                                                                                                                             |                |                                                                                                                                                     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 3) | *Revised drawings/documents along with compliance sheet incorporating all BHEL comments.<br><br><i>*Vendor to incorporate all BHEL comments so that further revisions can be minimized.</i> | Soft copy only | Within 1 weeks of receipt of commented Drawings from BHEL                                                                                           |
| 4) | BHEL shall furnish their observation on submitted documents                                                                                                                                 | Soft copy only | Within 2 weeks of document submission                                                                                                               |
| 5) | Final Drawings/documents                                                                                                                                                                    | 12             | Within 2 months of placement of order.                                                                                                              |
| 6) | Erection Documentation                                                                                                                                                                      | 5              | 1 month before dispatch of equipment. The list of documents identified under master document list for erection to be furnished in 5 no's of folders |
| 7) | Draft O & M Manuals for BHEL review.<br><br><i>Note: Bidder to furnish final hard copy of O&amp;M only after getting concurrence on soft copy.</i>                                          | Soft copy      | At least 2 months before the delivery date of equipment                                                                                             |
| 8) | Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)                                                                                                            | 12             | Within one month before the delivery date of equipment                                                                                              |
| 9) | Final O&M manuals in a CD                                                                                                                                                                   | 4              | Within one month after dispatch of equipment after BHEL concurrence on soft copy.                                                                   |

**Notes:**

The O&M manuals shall contain the following as minimum:

- The identification details of the equipment like BHEL P.O. No., Vendor's Job Identification No., full contact address with telephone, fax, & e-mail details.
- Brief description of the system.
- All approved documents [ Drawings, documents & test procedures as per MDL]
- Bill of material, BBU, LO schedule, sub vendor list, Mandatory & commissioning spares list etc.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 31 of 34     |    |

- e) Operation, Instruction & maintenance manuals of all equipments / items for the complete package
- f) System unloading, storage erection, start up, commissioning, shut down requirements.
- g) Operational & environmental safety instructions.
- h) Test reports and certificates.
- i) Catalogues of the equipment & instrumentation.

#### 14. PRICE BID FORMAT

Bidder to indicate his offer as per Price Bid format enclosed as Annexure-3A, 3B, 3C & 3D.

All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications as per annexure-11, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment. Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be in bidder scope Only.

Main offer consists of those items, which will be part of main order after successful bidder is identified. Optional Items consists of those items, which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format. Prices quoted by the bidder shall remain firm till the successful handing over of the entire package to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

The Priced Bid shall be submitted in Original (without any copy) duly signed and stamped on each page in a separate sealed envelope super scribing "Price Bid –Do not Open" This shall not contain any condition whatsoever failing which the Bids shall be liable to be rejected. In case of any correction, the bidder shall put its signature and its stamp. Eraser fluid will not be allowed for making any correction.

Bidder shall confirm to the un-priced bid as part of their offer.

#### 15. PRE-BID CLARIFICATIONS

Bidders shall comply with various requirements of this specification. It may please be noted that the requirements specified here in this specification are the standard practices being followed by the bidders. However, same things are presented in a structured form so that it can be ensured that the requirements of ultimate customer are complied with.

Bidders can bring out only those deviations which are impractical to meet, for our review in pre bid clarification only.

|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 32 of 34     |    |

Bidders may also please note that the data sheets for valves, instruments etc., submitted along with the offer will be considered as indicative only, as the requirements specified in the specification are standard in nature. These will not be reviewed by BHEL before award of contract. Same will be reviewed during order execution stage in line with the requirements of specification and agreed deviations.

All pre-bid clarifications & deviations shall be clear bring as per Annexure 11 only.

In case bidder doesn't bring any clarification/deviation in prebid stage, the same shall be brought in their offer with following conditions:

- a) Any deviations to Customer specifications, same are acceptable provided these deviations are also regularly accepted by Customer for their direct orders on bidders. In such cases, proof of the same shall be furnished along with the offer.
- b) Bidders may please note that unless the deviations are specifically brought out under deviations clause, it will be considered that no deviations are taken, even if they are mentioned elsewhere directly/indirectly in the offer.
- c) Price implication due to non-acceptance [by BHEL/Customer] of the deviations considered by bidder will not be permitted.
- d) Deviations [if any] shall be clear bring as per Annexure 10 only.

#### 16. VARIANT TABLE:

| Variant | Item                                      | Material Code |
|---------|-------------------------------------------|---------------|
| 01      | Hydrant & Spray Pump Motor driven         | PY9751464013  |
| 02      | Hydrant & Spray Pump Engine driven        | PY9751464021  |
| 51      | Supervision of E&C - Hydrant & Spray Pump | PY9851464511  |
| 06      | Hydrant & Spray Pump-Mandatory spare      | PY9751464064  |
| 07      | Hydrant Booster Pump Motor driven         | PY9751464072  |
| 08      | Hydrant Booster Pump Engine driven        | PY9751464080  |
| 52      | Supervision of E&C - Hydrant Booster Pump | PY9851464520  |
| 13      | Hydrant Booster Pump -Mandatory spare     | PY9751464137  |
| 14      | Spray Booster Pump Motor driven           | PY9751464145  |
| 15      | Spray Booster Pump Engine driven          | PY9751464153  |
| 53      | Supervision of E&C- Spray Booster Pump    | PY9851464538  |



|                       |                                                                                   |                                                                                                                         |  |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>     |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet 33 of 34     |    |

|    |                                       |              |
|----|---------------------------------------|--------------|
| 20 | Spray Booster Pump -Mandatory spare   | PY9751464200 |
| 21 | Jockey Pump with Drive Motor assembly | PY9751464218 |
| 54 | Supervision of E&C - Jockey Pump      | PY9851464546 |
| 25 | Jockey Pump -Mandatory spare          | PY9751464250 |

|                       |                                                                                   |                                                                                                                         |  |                              |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--|------------------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>PRODUCT STANDARD</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b> |  | Std. / Doc. Number           |    |
|                       |                                                                                   |                                                                                                                         |  | <b>PY51464</b>               |    |
|                       |                                                                                   |                                                                                                                         |  | Rev. No.                     | 00 |
|                       |                                                                                   |                                                                                                                         |  | Sheet <b>34</b> of <b>34</b> |    |

| RECORD OF REVISIONS |          |                  |            |                         |
|---------------------|----------|------------------|------------|-------------------------|
| Rev. No.            | Date     | Revision Details | Revised By | Approved By             |
| 00                  | 03.03.20 | First Issue      | -----      | Surya Satya<br>Nagesh M |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |
|                     |          |                  |            |                         |

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-1         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

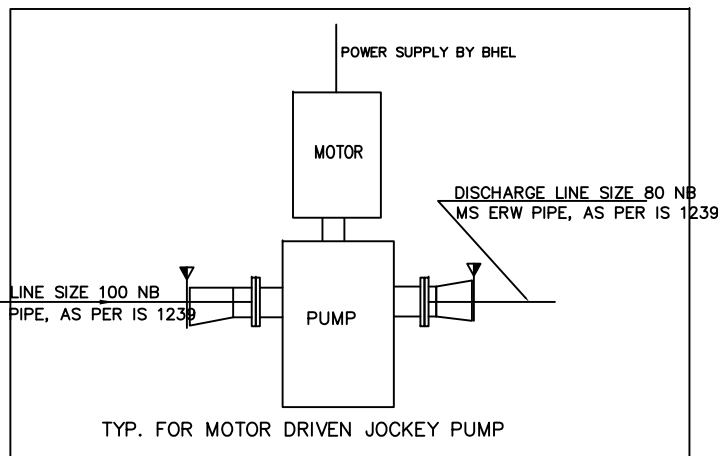
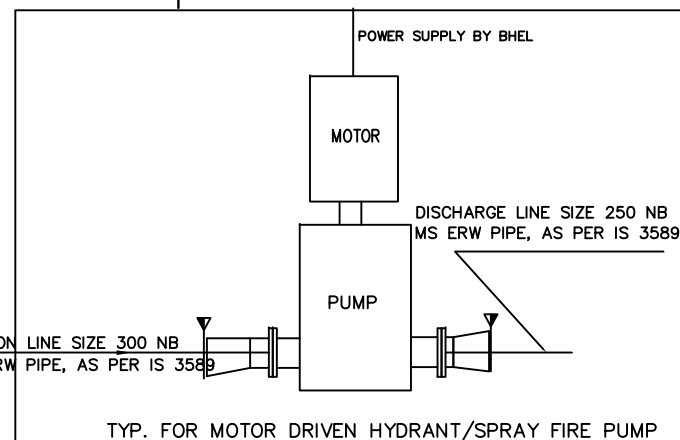
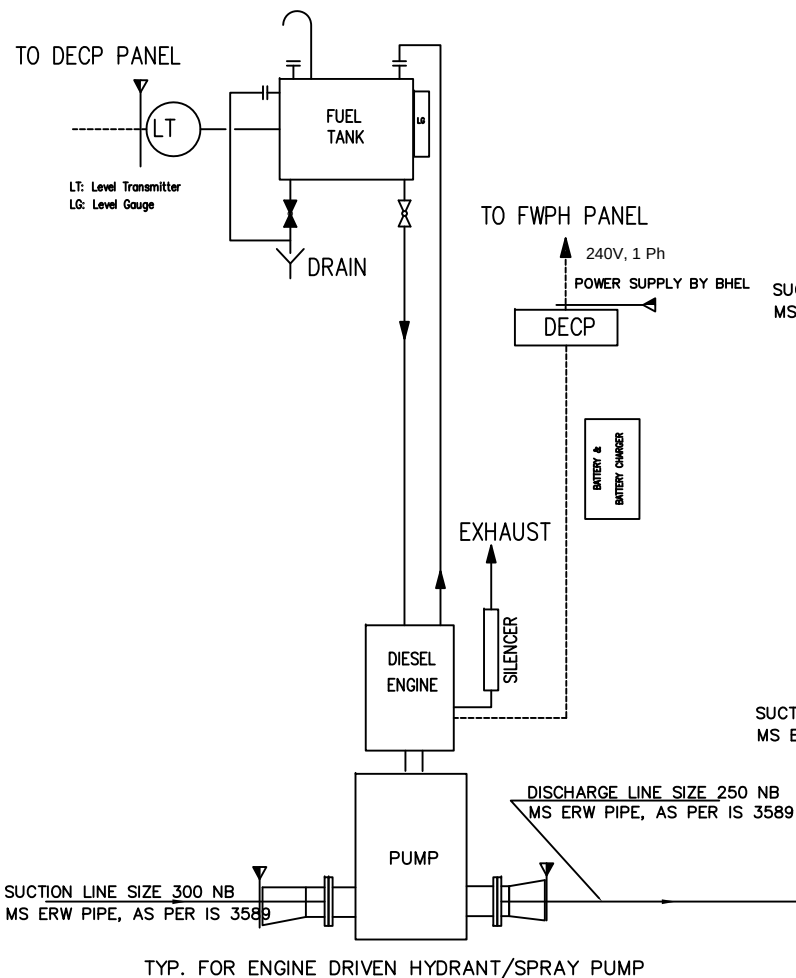
**COPYRIGHT AND CONFIDENTIAL**  
 The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED**,  
 It must not be used directly or indirectly in any way detrimental to the interest of the company.

# Annexure-1

- 1.P&ID for Pump & Drive assembly**
- 2.Layout**
- 3. Exhaust Piping layout**

|                                                   |                      |                     |                      |               |
|---------------------------------------------------|----------------------|---------------------|----------------------|---------------|
| <b>Revisions:</b><br>Refer to record of revisions | <b>Prepared by :</b> | <b>Checked by :</b> | <b>Approved by :</b> | <b>Date :</b> |
|                                                   | RATISH KUMAR         | GIRISH PALO         | SURYA SATYA NAGESH M | 10.03.20      |

## ANNEXURE-1



1. For scope of supply specification shall be referred.
2. This is typical schematic of Fire water Pumps & Jockey Pumps.
3. Suitable Reducer/Expander to meet BHEL pipe sizes shall be in bidder scope of supply.
4. Following standards shall be applicable: (For details, pls refer cl no 6.6)  
Pipe: IS 3589 for 200 NB and above IS 1239 up to 150 NB  
Pipe Fitting: ASTM SA 234 WPB  
Flanges/Companion Flanges: ASTM A 105
5. In case of HE cooled Diesel Engine, required Piping, valves etc shall be bidder scope of supply
6. Layout shall be referred for deciding BOQ for fuel piping, Exhaust piping, cabling etc. which are in bidder scope of supply.

BHEL SCOPE

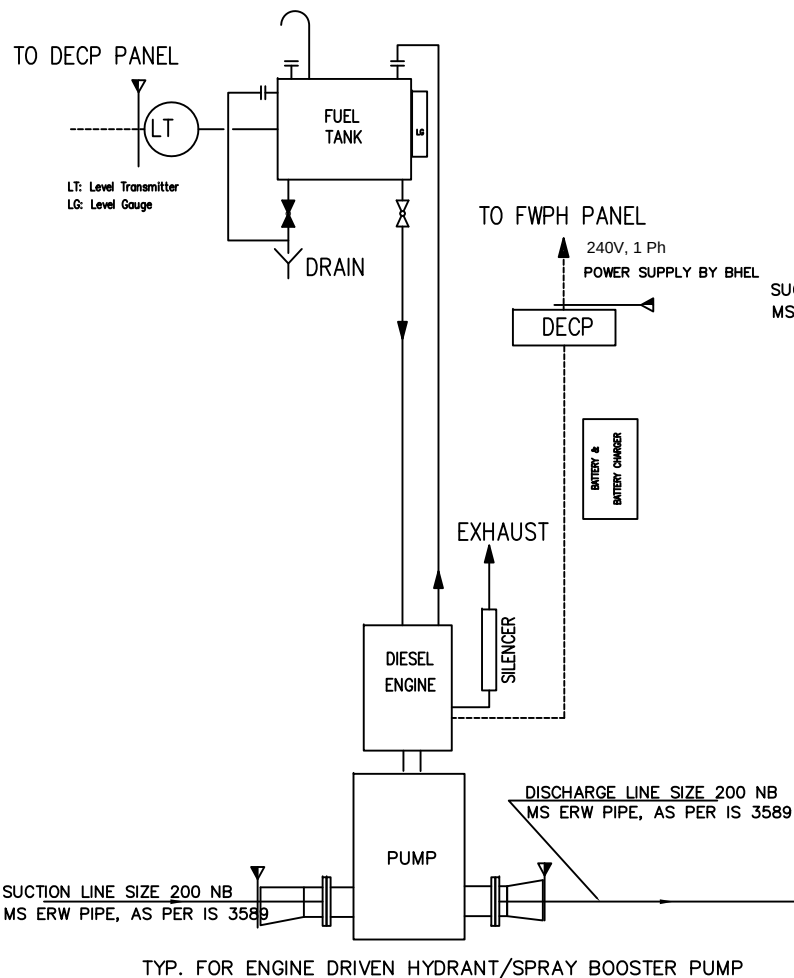
VENDOR SCOPE

CUSTOMER: M/s TELANGANA STATE POWER GENERATION LTD.  
(TSGENCO)PROJECT: 6X800 MW YADADRI THERMAL POWER STATION PROJECT,  
NALGONDA, TELANGANA

|                                                                                       |                               |                                                                                       |  |                |                     |                            |       |                  |                         |
|---------------------------------------------------------------------------------------|-------------------------------|---------------------------------------------------------------------------------------|--|----------------|---------------------|----------------------------|-------|------------------|-------------------------|
|  |                               | BHARAT HEAVY ELECTRICALS LTD.<br>HYDERABAD                                            |  |                |                     | NAME                       | SIGN. | DATE             | NO. OF<br>VAR.          |
|                                                                                       |                               |                                                                                       |  | DRN.           |                     | RATISH                     | -SD-  | 10.03.20         | N.A.                    |
|                                                                                       |                               |                                                                                       |  | CHD.           |                     | GIRISH                     | -SD-  | 10.03.20         | N.A.                    |
|                                                                                       |                               |                                                                                       |  | APPD.          |                     | MSSN                       | -SD-  | 10.03.20         | N.A.                    |
| DEPT.<br>PE&SD                                                                        | UNTOL. DIMS.<br>GR<br>9/11/17 |  |  | SCALE<br>N.T.S | WEIGHT (KG)<br>N.A. | REF. TO ASSY. DRG.<br>N.A. |       | ITEM NO.<br>N.A. | NO. OF<br>ITEMS<br>N.A. |
| TITLE                                                                                 |                               |                                                                                       |  |                | CARD<br>CODE        | DRG. NO. PESD/YADADRI/001  |       | REV.             |                         |
| SCHEME FOR HYDRANT/<br>SPRAY AND JOCKEY PUMPS                                         |                               |                                                                                       |  |                | NA                  | CUST. DRG. NO.             |       | 00               |                         |
|                                                                                       |                               |                                                                                       |  |                |                     | SHT. No                    | 01    | NO. OF SHT.      | 02                      |

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)



POWER SUPPLY BY BHEL

MOTOR

DISCHARGE LINE SIZE 200 NB  
MS ERW PIPE, AS PER IS 3589

PUMP

SUCTION LINE SIZE 200 NB  
MS ERW PIPE, AS PER IS 3589

TYP. FOR MOTOR DRIVEN HYDRANT/SPRAY BOOSTER PUMP

## ANNEXURE-1

## SCOPE OF SUPPLY FOR HYDRANT/SPRAY BOOSTER PUMP.

1. For scope of supply specification shall be referred.
2. This is typical schematic of Fire water Pumps & Jockey Pumps.
3. Suitable Reducer/Expander to meet BHEL pipe sizes shall be in bidder scope of supply.
4. Following standards shall be applicable: (For details, pls refer cl no 6.6)  
Pipe: IS 3589 for 200 NB and above IS 1239 up to 150 NB  
Pipe Fitting: ASTM SA 234 WPB  
Flanges/Companion Flanges: ASTM A 105
5. In case of HE cooled Diesel Engine, required Piping, valves etc shall be bidder scope of supply
6. Layout shall be refereed for deciding BOQ for fuel piping, Exhaust piping, cabling etc. which are in bidder scope of supply.

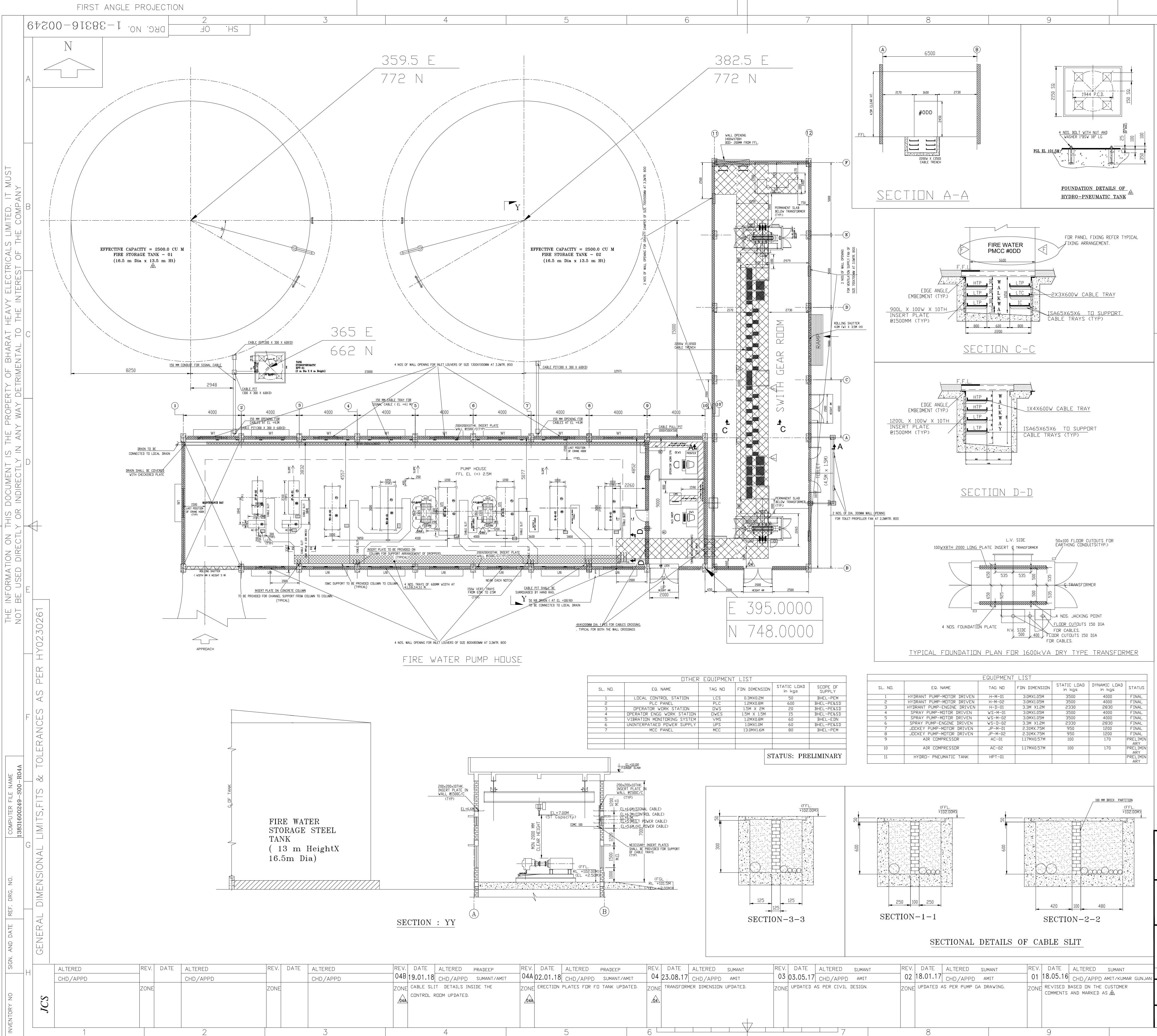
BHEL SCOPE

VENDOR SCOPE

CUSTOMER: M/s TELANGANA STATE POWER GENERATION LTD.  
(TSGENCO)PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT,  
NALGONDA, TELANGANA

|                                                                                       |                              |                |                     |                                                                                       |  |  |                  |                         |      |          |      |
|---------------------------------------------------------------------------------------|------------------------------|----------------|---------------------|---------------------------------------------------------------------------------------|--|--|------------------|-------------------------|------|----------|------|
|  |                              |                |                     | BHARAT HEAVY ELECTRICALS LTD.                                                         |  |  | NAME             |                         | DATE | NO. OF   |      |
|                                                                                       |                              |                |                     | HYDERABAD                                                                             |  |  | DRN.             | RATISH                  | -SD- | 10.03.20 | VAR. |
|                                                                                       |                              |                |                     |  |  |  | CHD.             | GIRISH                  | -SD- | 10.03.20 | N.A. |
|                                                                                       |                              |                |                     |                                                                                       |  |  | APPD.            | MSSN                    | -SD- | 10.03.20 |      |
| DEPT.<br>PE&SD<br>CODE<br>450                                                         | UNTOL. DIMS.<br>GR<br>9/11/1 | SCALE<br>N.T.S | WEIGHT (KG)<br>N.A. | REF. TO ASSY. DRG.<br>N.A.                                                            |  |  | ITEM NO.<br>N.A. | NO. OF<br>ITEMS<br>N.A. |      |          |      |
| TITLE                                                                                 |                              |                |                     | DRG. NO. PESD/YADADRI/001                                                             |  |  |                  |                         | REV. |          |      |
| SCHEME FOR HYDRANT/<br>SPRAY BOOSTER PUMPS                                            |                              |                |                     | CUST. DRG. NO.                                                                        |  |  |                  |                         | 00   |          |      |
|                                                                                       |                              |                |                     | SHT. No 02 1 NO. OF SHT. 02                                                           |  |  |                  |                         |      |          |      |

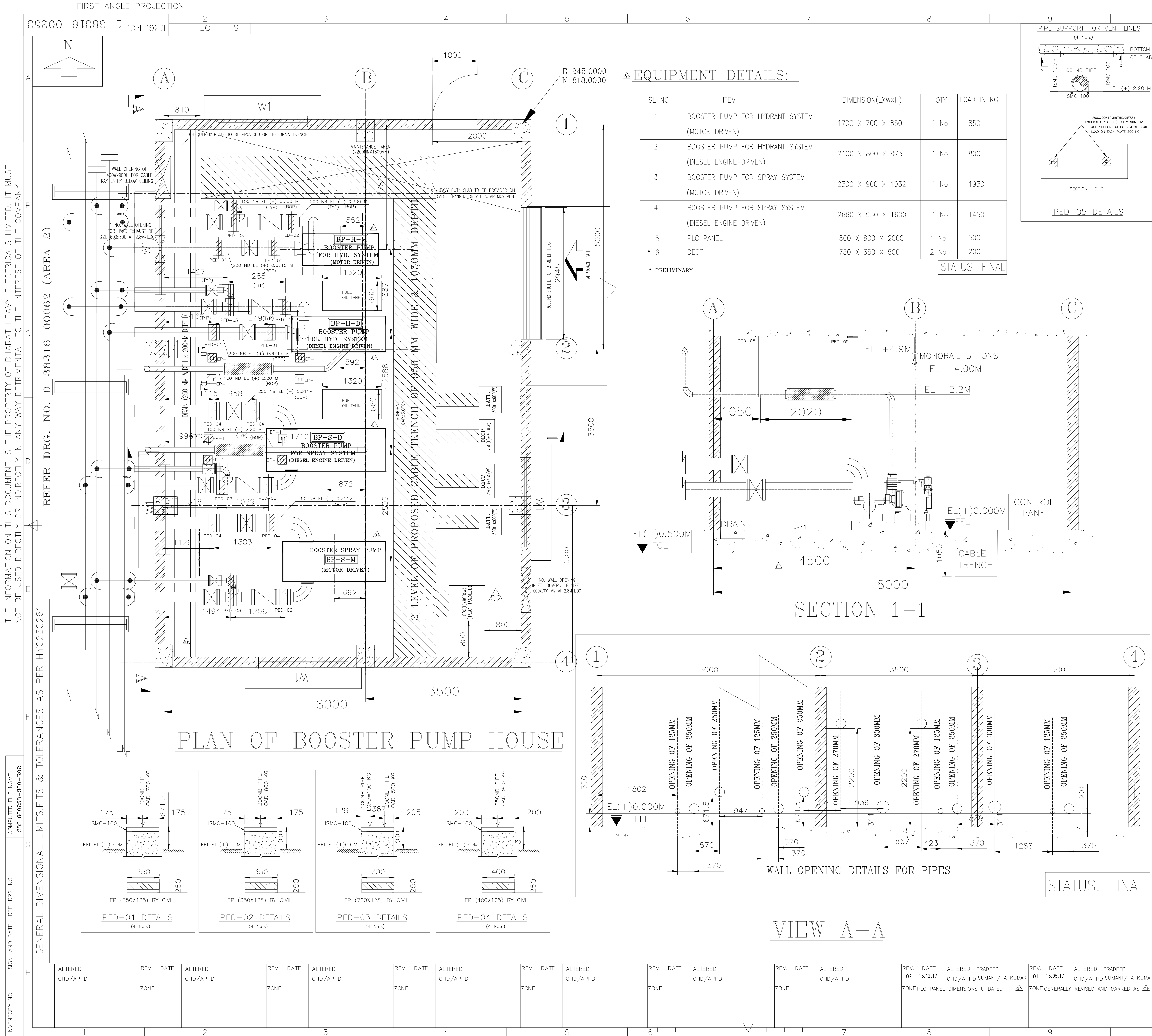




THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

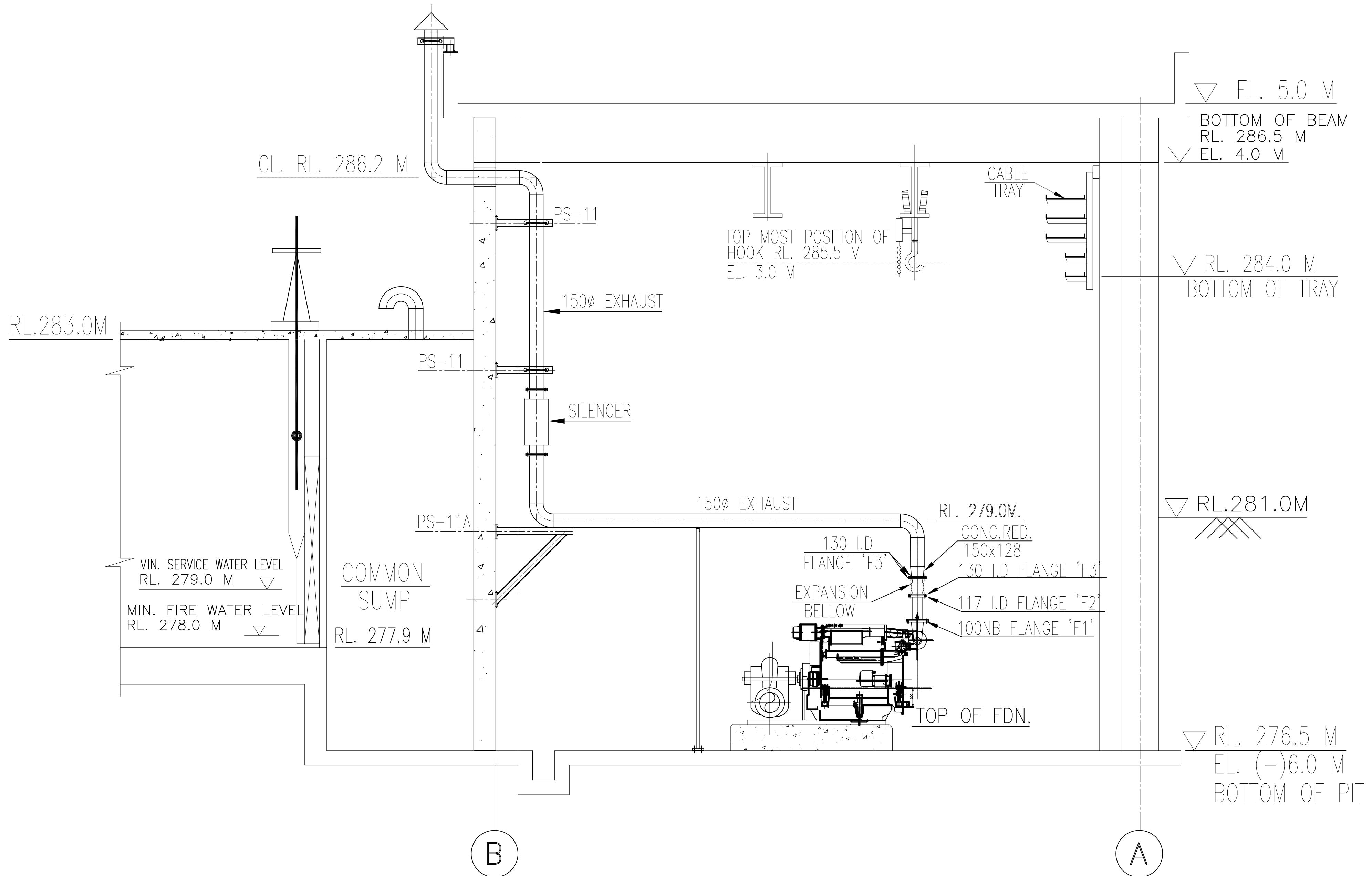
INVENTORY NO. JCS  
SIGN. AND DATE  
REF. DRG. NO. 13831600249-500-B04A  
COMPUTER FILE NAME 13831600249-500-B04A







# Preliminary layout



## DETAIL OF ENGINE EXHAUST

### NOTES:

FLANGE 'F2' SHALL BE SPECIALLY MADE WITH I.D=117MM AND ALL OTHER DIMENSIONS MATCHING WITH THAT OF FLANGE 'F3' WHICH IS ALREADY SUPPLIED ALONG WITH BELLOW.



|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-2         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

**COPYRIGHT AND CONFIDENTIAL**  
 The information on this document is the property of **BHARAT HEAVY ELECTRICALS LIMITED**,  
 It must not be used directly or indirectly in any way detrimental to the interest of the company.

# Annexure-2

## Hydrant/Spray, Booster & Jockey Pump-Motor-Engine datasheet

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| ANNEXURE-2A : DATA SHEET FOR HYDRANT/SPRAY PUMP -MOTOR-DIESEL ENGINE |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                      |         |
|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Sl.no                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BHEL Requirement                                                                                                                                                                                                                     | DETAILS |
| <b>GENERAL DATA</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                      |         |
| 1                                                                    | Service                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Hydrant Pump</b> : For supplying water to the Hydrant header/spray water system from the fire water storage sump<br><b>Spray water Pump</b> : For supplying the water to the spray water system from the Fire water storage sump. |         |
| 2                                                                    | Number of Pumps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5 No. of Hydrant pump [3 motor driven +2 Diesel Engine driven]<br>3 No. of Hydrant pump [2 motor driven +1 Diesel Engine driven]<br>Total : 8 Nos. [5 Nos. Motor driven+ 3 No. Diesel Engine driven]                                 |         |
| 3                                                                    | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Indoor                                                                                                                                                                                                                               |         |
| 4                                                                    | Duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Intermittent. However pump shall be suitable for continuous operation.                                                                                                                                                               |         |
| 5                                                                    | Drives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Motor & Diesel Engine                                                                                                                                                                                                                |         |
| 6                                                                    | Pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Water                                                                                                                                                                                                                                |         |
| 7                                                                    | Fluid temp Deg C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Ambient                                                                                                                                                                                                                              |         |
| <b>PUMP PERFORMANCE &amp; OTHER DETAILS</b>                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                      |         |
| 8                                                                    | Pump Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Horizontal, Centrifugal type                                                                                                                                                                                                         |         |
| 9                                                                    | Design Standard of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | HIS/IS 5120/ Equivalent standard<br>The pumps shall comply with the regulations of Tariff Advisory Committee (TAC).                                                                                                                  |         |
| 10                                                                   | Rated Flow (m <sup>3</sup> /hr)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 410                                                                                                                                                                                                                                  |         |
| 11                                                                   | Rated Differential Head (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 115                                                                                                                                                                                                                                  |         |
| 12                                                                   | Inline with TAC requirement,Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of no less than 65 % of the rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                      |         |
| 13                                                                   | Temperature of pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Ambient                                                                                                                                                                                                                              |         |
| 14                                                                   | Pump Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Pump model shall be interchangeable for both Motor & Engine driven pump. Bidder to indicate pump model                                                                                                                               |         |
| 15                                                                   | No. of Stages of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 16                                                                   | Parallel operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes.<br>Load sharing between Pumps:Not exceeding 5% over entire operating range when operating in parallel with other pumps                                                                                                          |         |
| 17                                                                   | Rated Speed of Pump (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1500                                                                                                                                                                                                                                 |         |
| 18                                                                   | Rated speed of Motor (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1500                                                                                                                                                                                                                                 |         |
| 19                                                                   | Rated speed of Engine (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1500                                                                                                                                                                                                                                 |         |
| 20                                                                   | Pump Efficiency in %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 21                                                                   | Available Pressure at centre line of Suction nozzle of Pump mlc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1.0 kg/cm <sup>2</sup> (a)                                                                                                                                                                                                           |         |
| 22                                                                   | NPSH(A) at pump suction nozzle (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 10.0 m                                                                                                                                                                                                                               |         |
| 23                                                                   | NPSH(R) (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bidder to furnish.                                                                                                                                                                                                                   |         |
| 24                                                                   | NPSH(A) - NPSH(R)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 m at rated condition & NPSHR shall be less than NPSHA upto end of the curve condition.                                                                                                                                             |         |
| 25                                                                   | Pump shut off head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Flow vs Head curve shall be continuously rising towards shut-off head.                                                                                                                                                               |         |
| 26                                                                   | Pump shut off head/rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Shall not be exceed 120% of rated head as per TAC.                                                                                                                                                                                   |         |
| 27                                                                   | BEP of the offered pump, m <sup>3</sup> /Hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 28                                                                   | Thermal minimum flow , m <sup>3</sup> /H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 29                                                                   | Stable minimum flow, m <sup>3</sup> /H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 30                                                                   | Pump End of the curve flow, m <sup>3</sup> /hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 31                                                                   | Impeller type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 32                                                                   | Pump rated impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 33                                                                   | Pump max. impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 34                                                                   | Pump minimum impeller dia., mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                                                                                                                                    |         |
| 35                                                                   | Material of Construction:<br>Casing : 2.5% Ni CI as per IS:210 Gr. FG 260<br>Casing Liner : 2.5% Ni CI as per IS:210 Gr. FG 260<br>Impeller : ASTM - A 743 GR. CF 8 M<br>Wearing rings : SS-304<br>Pump Shaft: AISI 410 (Hardened)<br>Coupling: SS316<br>Base plate : Carbon steel as per IS-2062<br>Wetter Fasteners: SS-316<br>Mechanical Seal: As per Manufacturer's Standard<br>Companion Flange : Carbon Steel as per IS-2062<br>Note: Bidder to confirm that the casing material mentioned above shall cater to the max. discharge pressure(i.e Pressure at shut off condition + maximum suction pressure) including all tolerance.If not, bidder to consider superior material of casing. |                                                                                                                                                                                                                                      |         |
| 36                                                                   | Sealing arrangement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Mechanical seal as per Manufacturer's Standard                                                                                                                                                                                       |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no.                                                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 | BHEL Requirement                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DETAILS |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 37                                                                                             | Flushing Plan                                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 38                                                                                             | Cooling Plan                                                                                                                                                                                                                                                                                                                                                                                                                                | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 39                                                                                             | Vendor shall clearly indicate the type of cooling system adopted. In case water is used as a cooling media [for pump/motor/engine] by tapping of the water from the pump discharge (before the pump discharge valve), the capacity of the pump shall be increased, so that the net capacity meets the specification requirement.. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 40                                                                                             | Type of axial thrust balancing arrangement                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 41                                                                                             | Type of main bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 42                                                                                             | Main bearings lubrication                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 43                                                                                             | Type of thrust bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                            | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 44                                                                                             | Thrust bearing lubrication                                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 45                                                                                             | Direction of rotation of Pump                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 46                                                                                             | Direction of rotation of Motor                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 47                                                                                             | Direction of rotation of Engine                                                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| <b>COUPLING</b>                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 48                                                                                             | Coupling standard                                                                                                                                                                                                                                                                                                                                                                                                                           | Manufacturer Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |
| 49                                                                                             | Type of coupling                                                                                                                                                                                                                                                                                                                                                                                                                            | Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer [The spacer length shall permit removal of the coupling, bearings, seal and rotor, as applicable, without disturbing the driver or the suction and discharge piping].                                                                                                                                                                               |         |
| 50                                                                                             | Non sparking type couplign guard                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| 51                                                                                             | Service factor for the coupling                                                                                                                                                                                                                                                                                                                                                                                                             | 1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| <b>PERFORMANCE TEST STANDARD FOR PUMPS</b>                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 52                                                                                             | Performance test standard                                                                                                                                                                                                                                                                                                                                                                                                                   | The testing Standards of the Pumps shall conform to the standards as indicated in TAC recommendation.<br>Performance tolerance shall be as mentioned below:<br>a) Rated head at rated flow: Zero negative tolerance<br>b) Shut-off head: Zero negative tolerance. 5% Positive tolerance permitted.<br>c) Rated BKW: Positive tolerance permitted till selected motor rating meets end of the curve condition<br>d) Efficiency at rated capacity: No negative tolerance |         |
| 53                                                                                             | Maximum Allowed Working Pressure (MAWP) in Kg/cm <sup>2</sup> g                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 54                                                                                             | Hydraulic test pressure of casing Kg/cm <sup>2</sup> (g)                                                                                                                                                                                                                                                                                                                                                                                    | Hydraulic test pressure of casing shall be 1.5 times the MAWP.Test duration shall be minimum <b>60 min.</b>                                                                                                                                                                                                                                                                                                                                                            |         |
| 55                                                                                             | Noise level for Pump                                                                                                                                                                                                                                                                                                                                                                                                                        | 85 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                                                                                                                                                                               |         |
| 56                                                                                             | Vibration for Pump                                                                                                                                                                                                                                                                                                                                                                                                                          | As ISO 10816                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |
| 57                                                                                             | Pump Instruments                                                                                                                                                                                                                                                                                                                                                                                                                            | Pressure Gauge at suction and Discharge                                                                                                                                                                                                                                                                                                                                                                                                                                |         |
| <b>PUMP TERMINAL POINT DETAILS</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 58                                                                                             | Pump Suction nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                           | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 59                                                                                             | Pump Discharge nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                         | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 60                                                                                             | Vent/Drain connection:<br>1.Vent with 3 way SS isolating valve<br>2.Drain connection with valve<br>3.Priming connection with 3 way SS isolating valve                                                                                                                                                                                                                                                                                       | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| <b>MOTOR DETAILS FOR MOTOR DRIVEN PUMPS [For More Details Please refer enclosed annexures]</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 61                                                                                             | Drive/Installation                                                                                                                                                                                                                                                                                                                                                                                                                          | Motor/Horizontal                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |
| 62                                                                                             | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 63                                                                                             | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 64                                                                                             | Selected drive rating in kW:<br>Continuous drive motor rating (at 50 degree C ambient) shall be higher of the following two conditions:<br>i) 110% of the duty point power requirement.<br>ii) Motor input power required at end of curve                                                                                                                                                                                                   | Bidder to mention Motor kW rating for the motor duly taking care of requirements.                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 65                                                                                             | Design Standard of Motor                                                                                                                                                                                                                                                                                                                                                                                                                    | IS 325, IS-12615, IEC-60034                                                                                                                                                                                                                                                                                                                                                                                                                                            |         |
| 66                                                                                             | Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                | BHEL - BHOPAL                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |
| 67                                                                                             | Ambient Temperature                                                                                                                                                                                                                                                                                                                                                                                                                         | 50 Deg C<br>All motors shall be designed to operate in humid atmosphere with ambient temperature of 50 Deg C.                                                                                                                                                                                                                                                                                                                                                          |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no.                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BHEL Requirement                                                                                                                                                                                                                                                                                                      | DETAILS |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 68                                                   | Area classification for motor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Safe Area                                                                                                                                                                                                                                                                                                             |         |
| 69                                                   | Rated Voltage & Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3.3 KV & 50 Hz                                                                                                                                                                                                                                                                                                        |         |
| 70                                                   | Permissible variations in Voltage/Frequency/Combined                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Voltage: (+/-)10%<br>Frequency: +3% & -5%<br>Combined: 10% combined variation of voltage and frequency                                                                                                                                                                                                                |         |
| 71                                                   | Quantity and Scope of supply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 5 Nos of HT Motors (for 3 Nos Hydrant pump & 2 No. Spray pump) are excluded from bidder scope supply. However, bidder shall consider canopy with legs and other fixing accessories. Also suitable common base frame for pump and motor assembly shall be provided by bidder for mounting the HT motor at site.        |         |
| <b>DIESEL ENGINE DETAILS FOR ENGINE DRIVEN PUMPS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                       |         |
| 72                                                   | Drive                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Diesel Engine                                                                                                                                                                                                                                                                                                         |         |
| 73                                                   | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The engine shall be naturally aspirated, super charged or turbo-charged as recommended by the manufacturer. Compression ignition, mechanical (air less) direct injection, multi cylinder and four stroke cycle and cold starting type.                                                                                |         |
| 74                                                   | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Indoor                                                                                                                                                                                                                                                                                                                |         |
| 75                                                   | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Bidder To Indicate                                                                                                                                                                                                                                                                                                    |         |
| 76                                                   | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Indicate                                                                                                                                                                                                                                                                                                    |         |
| 77                                                   | Selected drive rating:<br>i. The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.<br><br>ii. Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:<br><br>a. 3% for each 305 meter elevation above MSL<br>b. 1% for each 5.6° C rise in air temperature above 15.6° C<br><br>iii. The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee. | Bidder to mention engine HP rating for the motor duly taking care of the requirements.                                                                                                                                                                                                                                |         |
| 78                                                   | Drive Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Performance requirement of the diesel engine shall be guided by TAC/LPA recommendations. IS -10000, BS- 5514, ISO-3046, ISO-8528 and as per standard practice of diesel engine manufacturer's association of USA. Selection, Design and construction of the diesel engine shall be guided by the TAC recommendations. |         |
| 79                                                   | Name of Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Bidder to furnish.                                                                                                                                                                                                                                                                                                    |         |
| 80                                                   | Model No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder to furnish.                                                                                                                                                                                                                                                                                                    |         |
| 81                                                   | Duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Intermittent.<br>However, same shall be capable of operating continuously on full load at the site elevation for a period of six hours                                                                                                                                                                                |         |
| 82                                                   | Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1500 rpm                                                                                                                                                                                                                                                                                                              |         |
| 83                                                   | Type of cooling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder to Furnish                                                                                                                                                                                                                                                                                                     |         |
| 84                                                   | Noise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 105 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                             |         |
| 85                                                   | Vibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | As per ISO standard                                                                                                                                                                                                                                                                                                   |         |
| 86                                                   | <b>Note: Detailed format datasheet for Pump, Motor and Engine shall be furnished by BHEL. Bidder to submit duly filled in respective datasheets for BHEL approval in DDE stage.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                       |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| ANNEXURE-2B : DATA SHEET FOR HYDRANT BOOSTER PUMP-MOTOR-DIESEL ENGINE |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                    |         |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Sl.no.                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | BHEL Requirement                                                                                                                                                                                                                   | DETAILS |
| <b>GENERAL DATA</b>                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                    |         |
| 1                                                                     | Service                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | For circulating water from outlet of main Fire water Pump to Fire Protection Syatem Elevated Structures (Such as Boiler, Towers etc.)                                                                                              |         |
| 2                                                                     | Number of Pumps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2 Nos. for Hydrant Booster Pump[1W+1S]<br>[1 No. Motor + 1 No. Diesel Engine driven]                                                                                                                                               |         |
| 3                                                                     | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Pump House,Indoor                                                                                                                                                                                                                  |         |
| 4                                                                     | Duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Intermittent. However pump shall be suitable for continuous operation.                                                                                                                                                             |         |
| 5                                                                     | Drives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Motor & Diesel Engine                                                                                                                                                                                                              |         |
| 6                                                                     | Pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Water                                                                                                                                                                                                                              |         |
| 7                                                                     | Fluid temp Deg C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Ambient                                                                                                                                                                                                                            |         |
| <b>PUMP PERFORMANCE &amp; OTHER DETAILS</b>                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                    |         |
| 8                                                                     | Pump Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Horizontal, Centrifugal type                                                                                                                                                                                                       |         |
| 9                                                                     | Design Standard of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | HIS/IS 5120/ Equivalent standard<br>The pumps shall comply with the regulations of Tariff Advisory Committee (TAC).                                                                                                                |         |
| 10                                                                    | Rated Flow (m <sup>3</sup> /hr)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 171                                                                                                                                                                                                                                |         |
| 11                                                                    | Rated Differential Head (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 45                                                                                                                                                                                                                                 |         |
| 12                                                                    | Inline with TAC requirement,Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of no less than 65 % of the rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                    |         |
| 13                                                                    | Temperature of pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Ambient                                                                                                                                                                                                                            |         |
| 14                                                                    | Pump Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Pump model shall be interchangeable for both Motor & Engine driven pump. Bidder to indicate pump model                                                                                                                             |         |
| 15                                                                    | No. of Stages of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 16                                                                    | Parallel operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes.<br>Load sharing between Pumps:Not exceeding 5% over entire operating range when operating in parallel with other pumps                                                                                                        |         |
| 17                                                                    | Rated Speed of Pump (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1500                                                                                                                                                                                                                               |         |
| 18                                                                    | Rated speed of Motor (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1500                                                                                                                                                                                                                               |         |
| 19                                                                    | Rated speed of Engine (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1500                                                                                                                                                                                                                               |         |
| 20                                                                    | Pump Efficiency in %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 21                                                                    | Available Pressure at centre line of Suction nozzle of Pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 16.5 kg/cm <sup>2</sup> (a) [max]*<br>*Indicative value, However Available pressure at center line of suction nozzle =Main Hydrant Pump Shut off head + maximum 5% Positive tolerance on shut off head + Maximum suction pressure. |         |
| 22                                                                    | NPSH(A) at pump suction nozzle (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 80 m to 120                                                                                                                                                                                                                        |         |
| 23                                                                    | NPSH(R) (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder to furnish.                                                                                                                                                                                                                 |         |
| 24                                                                    | NPSH(A) - NPSH(R)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 m at rated condition & NPSHR shall be less than NPSHA upto end of the curve condition.                                                                                                                                           |         |
| 25                                                                    | Pump shut off head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Flow vs Head curve shall be continuously rising towards shut-off head.                                                                                                                                                             |         |
| 26                                                                    | Pump shut off head/rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Shall not be exceed 120% of rated head as per TAC.                                                                                                                                                                                 |         |
| 27                                                                    | BEP of the offered pump, m3/Hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 28                                                                    | Thermal minimum flow , m3/H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 29                                                                    | Stable minimum flow, m3/H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 30                                                                    | Pump End of the curve flow, m3/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 31                                                                    | Impeller type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 32                                                                    | Pump rated impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 33                                                                    | Pump max. impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 34                                                                    | Pump minimum impeller dia., mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                                                                                                                                  |         |
| 35                                                                    | Material of Construction:<br>Casing : CS ASTM A 216 Gr WCB<br>Casing Liner : CS ASTM A 216 Gr WCB<br>Impeller : ASTM - A 743 GR. CF 8 M<br>Wearing rings : SS-304<br>Pump Shaft: AISI 410 (Hardened)<br>Coupling: SS316<br>Base plate : Carbon steel as per IS-2062<br>Wetter Fasteners: SS-316<br>Mechanical Seal: As per Manufacturer's Standard<br>Companion Flange : Carbon Steel as per IS-2062<br>Note: Bidder to confirm that the casing material mentioned above shall cater to the max. discharge pressure(i.e Pressure at shut off condition + maximum suction pressure) including all tolerance.If not, bidder to consider superior material of casing. |                                                                                                                                                                                                                                    |         |
| 36                                                                    | Sealing arrangement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Mechanical seal as per Manufacturer's Standard                                                                                                                                                                                     |         |
| 37                                                                    | Flushing Plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                                  |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no.                                                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 | BHEL Requirement                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DETAILS |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 38                                                                                             | Cooling Plan                                                                                                                                                                                                                                                                                                                                                                                                                                | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 39                                                                                             | Vendor shall clearly indicate the type of cooling system adopted. In case water is used as a cooling media [for pump/motor/engine] by tapping of the water from the pump discharge (before the pump discharge valve), the capacity of the pump shall be increased, so that the net capacity meets the specification requirement.. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 40                                                                                             | Type of axial thrust balancing arrangement                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 41                                                                                             | Type of main bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 42                                                                                             | Main bearings lubrication                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 43                                                                                             | Type of thrust bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                            | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 44                                                                                             | Thrust bearing lubrication                                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 45                                                                                             | Direction of rotation of Pump                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 46                                                                                             | Direction of rotation of Motor                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 47                                                                                             | Direction of rotation of Engine                                                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| <b>COUPLING</b>                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 48                                                                                             | Coupling standard                                                                                                                                                                                                                                                                                                                                                                                                                           | Manufacturer Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |
| 49                                                                                             | Type of coupling                                                                                                                                                                                                                                                                                                                                                                                                                            | Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer [The spacer length shall permit removal of the coupling, bearings, seal and rotor, as applicable, without disturbing the driver or the suction and discharge piping].                                                                                                                                                                               |         |
| 50                                                                                             | Non sparking type couplign guard                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| 51                                                                                             | Service factor for the coupling                                                                                                                                                                                                                                                                                                                                                                                                             | 1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| <b>PERFORMANCE TEST STANDARD FOR PUMPS</b>                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 52                                                                                             | Performance test standard                                                                                                                                                                                                                                                                                                                                                                                                                   | The testing Standards of the Pumps shall conform to the standards as indicated in TAC recommendation.<br>Performance tolerance shall be as mentioned below:<br>a) Rated head at rated flow: Zero negative tolerance<br>b) Shut-off head: Zero negative tolerance. 5% Positive tolerance permitted.<br>c) Rated BkW: Positive tolerance permitted till selected motor rating meets end of the curve condition<br>d) Efficiency at rated capacity: No negative tolerance |         |
| 53                                                                                             | Maximum Allowed Working Pressure (MAWP) in Kg/cm <sup>2</sup> g                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 54                                                                                             | Hydraulic test pressure of casing Kg/cm <sup>2</sup> (g)                                                                                                                                                                                                                                                                                                                                                                                    | Hydraulic test pressure of casing shall be 1.5 times the MAWP. Test duration shall be minimum <b>60 min.</b>                                                                                                                                                                                                                                                                                                                                                           |         |
| 55                                                                                             | Noise level for Pump                                                                                                                                                                                                                                                                                                                                                                                                                        | 85 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                                                                                                                                                                               |         |
| 56                                                                                             | Vibration for Pump                                                                                                                                                                                                                                                                                                                                                                                                                          | As ISO 10816                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |
| 57                                                                                             | Pump Instruments                                                                                                                                                                                                                                                                                                                                                                                                                            | Pressure Gauge at suction and Discharge                                                                                                                                                                                                                                                                                                                                                                                                                                |         |
| <b>PUMP TERMINAL POINT DETAILS</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 58                                                                                             | Pump Suction nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                           | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 59                                                                                             | Pump Discharge nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                         | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 60                                                                                             | Vent/Drain connection:<br>1.Vent with 3 way SS isolating valve<br>2.Drain connection with valve<br>3.Priming connection with 3 way SS isolating valve                                                                                                                                                                                                                                                                                       | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| <b>MOTOR DETAILS FOR MOTOR DRIVEN PUMPS [For More Details Please refer enclosed annexures]</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 61                                                                                             | Drive/Installation                                                                                                                                                                                                                                                                                                                                                                                                                          | Motor/Horizontal                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |
| 62                                                                                             | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 63                                                                                             | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 64                                                                                             | Selected drive rating in kW:<br>Continuous drive motor rating (at 50 degree C ambient) shall be higher of the following two conditions:<br>i) 115% of the duty point power requirement.<br>ii) Motor input power required at end of curve                                                                                                                                                                                                   | Bidder to mention motor kW rating for the motor duly taking care of requirements.                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 65                                                                                             | Design Standard of Motor                                                                                                                                                                                                                                                                                                                                                                                                                    | IS 325, IS-12615, IEC-60034                                                                                                                                                                                                                                                                                                                                                                                                                                            |         |
| 66                                                                                             | Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                | As per attached subvendor list                                                                                                                                                                                                                                                                                                                                                                                                                                         |         |
| 67                                                                                             | Ambient Temperature                                                                                                                                                                                                                                                                                                                                                                                                                         | 50 Deg C<br>All motors shall be designed to operate in humid atmosphere with a maximum ambient temperature of 50 Deg C.                                                                                                                                                                                                                                                                                                                                                |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no.                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BHEL Requirement                                                                                                                                                                                                                                                                   | DETAILS |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 68                                                   | Area classification for motor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Safe Area                                                                                                                                                                                                                                                                          |         |
| 69                                                   | Rated Voltage & Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 415 V & 50 Hz                                                                                                                                                                                                                                                                      |         |
| 70                                                   | Permissible variations in Voltage/Frequency/Combined                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Voltage: (+/-)10%<br>Frequency: +3% & -5%<br>Combined: 10% combined variation of voltage and frequency                                                                                                                                                                             |         |
| 71                                                   | No of poles / synchronous speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4/1500 rpm                                                                                                                                                                                                                                                                         |         |
| 72                                                   | Energy efficient class                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | IE3                                                                                                                                                                                                                                                                                |         |
| 73                                                   | Starting Current as % of FLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 600% subject to IS tolerance                                                                                                                                                                                                                                                       |         |
| 74                                                   | Method of Starting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | AC squirrel cage industrial motors shall be fed at 415V, 3 phase, 50 Hz, with DOL start as applicable.                                                                                                                                                                             |         |
| 75                                                   | Method of cooling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type                                                                                                                                  |         |
| 76                                                   | Winding and Insulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All insulated winding shall be of copper.<br>Motors shall have class F insulation but limited to class B temperature rise.<br>Windings shall be impregnated to make them non-hygroscopic and oil resistant.                                                                        |         |
| 78                                                   | Space Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.                                                             |         |
| 79                                                   | Degree of protection/Canopy Required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | IP 55/Yes & to be supplied by bidder                                                                                                                                                                                                                                               |         |
| 80                                                   | TB Short time-Current & Short time-Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 50 kA , 0.25 Sec                                                                                                                                                                                                                                                                   |         |
| 81                                                   | Cable, Cable glands & Lugs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Suitable double compression Nickel plated brass cable glands and Tinned copper lugs to be provided by the bidder.                                                                                                                                                                  |         |
| 82                                                   | No. of Starts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Motors shall be capable of three equally spread starts per hour under normal condition or two starts in quick succession from cold                                                                                                                                                 |         |
| 83                                                   | Bearing RTDs, Winding RTDs & TGs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Not Applicable                                                                                                                                                                                                                                                                     |         |
| 84                                                   | Noise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 85 DBA at 1 m distance from motor body, in any direction                                                                                                                                                                                                                           |         |
| 85                                                   | Vibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | As per IS standard                                                                                                                                                                                                                                                                 |         |
| <b>DIESEL ENGINE DETAILS FOR ENGINE DRIVEN PUMPS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                    |         |
| 86                                                   | Drive                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Diesel Engine                                                                                                                                                                                                                                                                      |         |
| 87                                                   | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The engine shall be naturally aspirated, super charged or turbo-charged as recommended by the manufacturer.<br>Compression ignition, mechanical (air less) direct injection, multi cylinder and four stroke cycle and cold starting type.<br>(Ref. Fire Protection Manual by TAC). |         |
| 88                                                   | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Indoor                                                                                                                                                                                                                                                                             |         |
| 89                                                   | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | As per TAC / Factory Mutual                                                                                                                                                                                                                                                        |         |
| 90                                                   | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                    |         |
| 91                                                   | Selected drive rating:<br>i. The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.<br><br>ii. Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:<br><br>a. 3% for each 305 meter elevation above MSL<br>b. 1% for each 5.6° C rise in air temperature above 15.6° C<br><br>iii. The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee. | Bidder to mention engine HP rating for the motor duly taking care of the requirements.                                                                                                                                                                                             |         |



**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no. | Description          | BHEL Requirement                                                                                                                                                                                                                                                                                                            | DETAILS |
|--------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 92     | Drive Standard       | Performance requirement of the diesel engine shall be guided by TAC/LPA recommendations.<br>IS -10000, BS- 5514, ISO-3046, ISO-8528 and as per standard practice of diesel engine manufacturer's association of USA.<br>Selection, Design and construction of the diesel engine shall be guided by the TAC recommendations. |         |
| 93     | Name of Manufacturer | Bidder to furnish.                                                                                                                                                                                                                                                                                                          |         |
| 94     | Model No             | Bidder to furnish.                                                                                                                                                                                                                                                                                                          |         |
| 95     | Duty                 | Intermittent.<br>However, same shall be capable of operating continuously on full load at the site elevation for a period of six hours.                                                                                                                                                                                     |         |
| 96     | Speed                | 1500 rpm                                                                                                                                                                                                                                                                                                                    |         |
| 97     | Type of cooling      | Bidder to Furnish                                                                                                                                                                                                                                                                                                           |         |
| 98     | Noise                | 105 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                                   |         |
| 99     | Vibration            | As per ISO standard                                                                                                                                                                                                                                                                                                         |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| ANNEXURE-2C : DATA SHEET FOR SPRAY BOOSTER PUMP-MOTOR-DIESEL ENGINE |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                        |         |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Sl.no.                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | BHEL Requirement                                                                                                                                                                                                       | DETAILS |
| <b>GENERAL DATA</b>                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                        |         |
| 1                                                                   | Service                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | For circulating water from outlet of main Fire water Pump to Fire Protection Syatem Elevated Structures (Such as Towers etc.)                                                                                          |         |
| 2                                                                   | Number of Pumps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2 Nos. for Spray Booster Pump[1W+1S]<br>[1 No. Motor + 1 No. Diesel Engine driven]                                                                                                                                     |         |
| 3                                                                   | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Pump House,Indoor                                                                                                                                                                                                      |         |
| 4                                                                   | Duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Intermittent. However pump shall be suitable for continuous operation.                                                                                                                                                 |         |
| 5                                                                   | Drives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Motor & Diesel Engine                                                                                                                                                                                                  |         |
| 6                                                                   | Pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Water                                                                                                                                                                                                                  |         |
| 7                                                                   | Fluid temp Deg C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Ambient                                                                                                                                                                                                                |         |
| <b>PUMP PERFORMANCE &amp; OTHER DETAILS</b>                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                        |         |
| 8                                                                   | Pump Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Horizontal, Centrifugal type                                                                                                                                                                                           |         |
| 9                                                                   | Design Standard of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | HIS/IS 5120/ Equivalent standard<br>The pumps shall comply with the regulations of Tariff Advisory Committee (TAC).                                                                                                    |         |
| 10                                                                  | Rated Flow (m <sup>3</sup> /hr)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 410                                                                                                                                                                                                                    |         |
| 11                                                                  | Rated Differential Head (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 45                                                                                                                                                                                                                     |         |
| 12                                                                  | Inline with TAC requirement,Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of no less than 65 % of the rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                        |         |
| 13                                                                  | Temperature of pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Ambient                                                                                                                                                                                                                |         |
| 14                                                                  | Pump Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Pump model shall be interchangeable for both Motor & Engine driven pump. Bidder to indicate pump model                                                                                                                 |         |
| 15                                                                  | No. of Stages of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                      |         |
| 16                                                                  | Parallel operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes.<br>Load sharing between Pumps:Not exceeding 5% over entire operating range when operating in parallel with other pumps                                                                                            |         |
| 17                                                                  | Rated Speed of Pump (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1500                                                                                                                                                                                                                   |         |
| 18                                                                  | Rated speed of Motor (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1500                                                                                                                                                                                                                   |         |
| 19                                                                  | Rated speed of Engine (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1500                                                                                                                                                                                                                   |         |
| 20                                                                  | Pump Efficiency in %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Furnish                                                                                                                                                                                                      |         |
| 21                                                                  | Available Pressure at centre line of Suction nozzle of Pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 16.5 kg/cm2 (a) [max]*<br>*Indicative value, However Available pressure at center line of suction nozzle =Main Hydrant Pump Shut off head + maximum 5% Positive tolerance on shut off head + Maximum suction pressure. |         |
| 22                                                                  | NPSH(A) at pump suction nozzle (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 80 m to 120                                                                                                                                                                                                            |         |
| 23                                                                  | NPSH(R) (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder to furnish.                                                                                                                                                                                                     |         |
| 24                                                                  | NPSH(A) - NPSH(R)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 m at rated condition & NPSHR shall be less than NPSHA upto end of the curve condition.                                                                                                                               |         |
| 25                                                                  | Pump shut off head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Flow vs Head curve shall be continuously rising towards shut-off head.                                                                                                                                                 |         |
| 26                                                                  | Pump shut off head/rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Shall not be exceed 120% of rated head as per TAC.                                                                                                                                                                     |         |
| 27                                                                  | BEP of the offered pump, m3/Hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                                                                                                                      |         |
| 28                                                                  | Thermal minimum flow , m3/H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bidder To Furnish                                                                                                                                                                                                      |         |
| 29                                                                  | Stable minimum flow, m3/H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bidder To Furnish                                                                                                                                                                                                      |         |
| 30                                                                  | Pump End of the curve flow, m3/hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                      |         |
| 31                                                                  | Impeller type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                      |         |
| 32                                                                  | Pump rated impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bidder To Furnish                                                                                                                                                                                                      |         |
| 33                                                                  | Pump max. impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Furnish                                                                                                                                                                                                      |         |
| 34                                                                  | Pump minimum impeller dia., mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                                                                                                                      |         |
| 35                                                                  | Material of Construction:<br>Casing : CS ASTM A 216 Gr WCB<br>Casing Liner : CS ASTM A 216 Gr WCB<br>Impeller : ASTM - A 743 GR. CF 8 M<br>Wearing rings : SS-304<br>Pump Shaft: AISI 410 (Hardened)<br>Coupling: SS316<br>Base plate : Carbon steel as per IS-2062<br>Wetter Fasteners: SS-316<br>Mechanical Seal: As per Manufacturer's Standard<br>Companion Flange : Carbon Steel as per IS-2062<br>Note: Bidder to confirm that the casing material mentioned above shall cater to the max. discharge pressure(i.e Pressure at shut off condition + maximum suction pressure) including all tolerance.If not, bidder to consider superior material of casing. |                                                                                                                                                                                                                        |         |
| 36                                                                  | Sealing arrangement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Mechanical seal as per Manufacturer's Standard                                                                                                                                                                         |         |
| 37                                                                  | Flushing Plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                      |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no.                                                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 | BHEL Requirement                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DETAILS |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 38                                                                                             | Cooling Plan                                                                                                                                                                                                                                                                                                                                                                                                                                | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 39                                                                                             | Vendor shall clearly indicate the type of cooling system adopted. In case water is used as a cooling media [for pump/motor/engine] by tapping of the water from the pump discharge (before the pump discharge valve), the capacity of the pump shall be increased, so that the net capacity meets the specification requirement.. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 40                                                                                             | Type of axial thrust balancing arrangement                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 41                                                                                             | Type of main bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 42                                                                                             | Main bearings lubrication                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 43                                                                                             | Type of thrust bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                            | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 44                                                                                             | Thrust bearing lubrication                                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 45                                                                                             | Direction of rotation of Pump                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 46                                                                                             | Direction of rotation of Motor                                                                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 47                                                                                             | Direction of rotation of Engine                                                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| <b>COUPLING</b>                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 48                                                                                             | Coupling standard                                                                                                                                                                                                                                                                                                                                                                                                                           | Manufacturer Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |
| 49                                                                                             | Type of coupling                                                                                                                                                                                                                                                                                                                                                                                                                            | Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer [The spacer length shall permit removal of the coupling, bearings, seal and rotor, as applicable, without disturbing the driver or the suction and discharge piping].                                                                                                                                                                               |         |
| 50                                                                                             | Non sparking type couplign guard                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| 51                                                                                             | Service factor for the coupling                                                                                                                                                                                                                                                                                                                                                                                                             | 1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| <b>PERFORMANCE TEST STANDARD FOR PUMPS</b>                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 52                                                                                             | Performance test standard                                                                                                                                                                                                                                                                                                                                                                                                                   | The testing Standards of the Pumps shall conform to the standards as indicated in TAC recommendation.<br>Performance tolerance shall be as mentioned below:<br>a) Rated head at rated flow: Zero negative tolerance<br>b) Shut-off head: Zero negative tolerance. 5% Positive tolerance permitted.<br>c) Rated BkW: Positive tolerance permitted till selected motor rating meets end of the curve condition<br>d) Efficiency at rated capacity: No negative tolerance |         |
| 53                                                                                             | Maximum Allowed Working Pressure (MAWP) in Kg/cm <sup>2</sup> g                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 54                                                                                             | Hydraulic test pressure of casing Kg/cm <sup>2</sup> (g)                                                                                                                                                                                                                                                                                                                                                                                    | Hydraulic test pressure of casing shall be 1.5 times the MAWP. Test duration shall be minimum <b>60 min.</b>                                                                                                                                                                                                                                                                                                                                                           |         |
| 55                                                                                             | Noise level for Pump                                                                                                                                                                                                                                                                                                                                                                                                                        | 85 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                                                                                                                                                                               |         |
| 56                                                                                             | Vibration for Pump                                                                                                                                                                                                                                                                                                                                                                                                                          | As ISO 10816                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |
| 57                                                                                             | Pump Instruments                                                                                                                                                                                                                                                                                                                                                                                                                            | Pressure Gauge at suction and Discharge                                                                                                                                                                                                                                                                                                                                                                                                                                |         |
| <b>PUMP TERMINAL POINT DETAILS</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 58                                                                                             | Pump Suction nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                           | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 59                                                                                             | Pump Discharge nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                         | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 60                                                                                             | Vent/Drain connection:<br>1.Vent with 3 way SS isolating valve<br>2.Drain connection with valve<br>3.Priming connection with 3 way SS isolating valve                                                                                                                                                                                                                                                                                       | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| <b>MOTOR DETAILS FOR MOTOR DRIVEN PUMPS [For More Details Please refer enclosed annexures]</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 61                                                                                             | Drive/Installation                                                                                                                                                                                                                                                                                                                                                                                                                          | Motor/Horizontal                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |
| 62                                                                                             | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 63                                                                                             | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 64                                                                                             | Selected drive rating in kW:<br>Continuous drive motor rating (at 50 degree C ambient) shall be higher of the following two conditions:<br>i) 115% of the duty point power requirement.<br>ii) Motor input power required at end of curve                                                                                                                                                                                                   | Bidder to mention motor kW rating for the motor duly taking care of requirements.                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 65                                                                                             | Design Standard of Motor                                                                                                                                                                                                                                                                                                                                                                                                                    | IS 325, IS-12615, IEC-60034                                                                                                                                                                                                                                                                                                                                                                                                                                            |         |
| 66                                                                                             | Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                | As per attached subvendor list                                                                                                                                                                                                                                                                                                                                                                                                                                         |         |
| 67                                                                                             | Ambient Temperature                                                                                                                                                                                                                                                                                                                                                                                                                         | 50 Deg C<br>All motors shall be designed to operate in humid atmosphere with a maximum ambient temperature of 50 Deg C.                                                                                                                                                                                                                                                                                                                                                |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no.                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BHEL Requirement                                                                                                                                                                                                                                                                   | DETAILS |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 68                                                   | Area classification for motor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Safe Area                                                                                                                                                                                                                                                                          |         |
| 69                                                   | Rated Voltage & Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 415 V & 50 Hz                                                                                                                                                                                                                                                                      |         |
| 70                                                   | Permissible variations in Voltage/Frequency/Combined                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Voltage: (+/-)10%<br>Frequency: +3% & -5%<br>Combined: 10% combined variation of voltage and frequency                                                                                                                                                                             |         |
| 71                                                   | No of poles / synchronous speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4/1500 rpm                                                                                                                                                                                                                                                                         |         |
| 72                                                   | Energy efficient class                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | IE3                                                                                                                                                                                                                                                                                |         |
| 73                                                   | Starting Current as % of FLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 600% subject to IS tolerance                                                                                                                                                                                                                                                       |         |
| 74                                                   | Method of Starting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | AC squirrel cage industrial motors shall be fed at 415V, 3 phase, 50 Hz, with DOL start as applicable.                                                                                                                                                                             |         |
| 75                                                   | Method of cooling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type                                                                                                                                  |         |
| 76                                                   | Winding and Insulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All insulated winding shall be of copper.<br>Motors shall have class F insulation but limited to class B temperature rise.<br>Windings shall be impregnated to make them non-hygroscopic and oil resistant.                                                                        |         |
| 78                                                   | Space Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.                                                             |         |
| 79                                                   | Degree of protection/Canopy Required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | IP 55/Yes & to be supplied by bidder                                                                                                                                                                                                                                               |         |
| 80                                                   | TB Short time-Current & Short time-Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 50 kA , 0.25 Sec                                                                                                                                                                                                                                                                   |         |
| 81                                                   | Cable, Cable glands & Lugs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Suitable double compression Nickel plated brass cable glands and Tinned copper lugs to be provided by the bidder.                                                                                                                                                                  |         |
| 82                                                   | No. of Starts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Motors shall be capable of three equally spread starts per hour under normal condition or two starts in quick succession from cold                                                                                                                                                 |         |
| 83                                                   | Bearing RTDs, Winding RTDs & TGs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Not Applicable                                                                                                                                                                                                                                                                     |         |
| 84                                                   | Noise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 85 DBA at 1 m distance from motor body, in any direction                                                                                                                                                                                                                           |         |
| 85                                                   | Vibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | As per IS standard                                                                                                                                                                                                                                                                 |         |
| <b>DIESEL ENGINE DETAILS FOR ENGINE DRIVEN PUMPS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                    |         |
| 86                                                   | Drive                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Diesel Engine                                                                                                                                                                                                                                                                      |         |
| 87                                                   | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The engine shall be naturally aspirated, super charged or turbo-charged as recommended by the manufacturer.<br>Compression ignition, mechanical (air less) direct injection, multi cylinder and four stroke cycle and cold starting type.<br>(Ref. Fire Protection Manual by TAC). |         |
| 88                                                   | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Indoor                                                                                                                                                                                                                                                                             |         |
| 89                                                   | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | As per TAC / Factory Mutual                                                                                                                                                                                                                                                        |         |
| 90                                                   | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                    |         |
| 91                                                   | Selected drive rating:<br>i. The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.<br><br>ii. Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:<br><br>a. 3% for each 305 meter elevation above MSL<br>b. 1% for each 5.6° C rise in air temperature above 15.6° C<br><br>iii. The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee. | Bidder to mention engine HP rating for the motor duly taking care of the requirements.                                                                                                                                                                                             |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no. | Description          | BHEL Requirement                                                                                                                                                                                                                                                                                                            | DETAILS |
|--------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 92     | Drive Standard       | Performance requirement of the diesel engine shall be guided by TAC/LPA recommendations.<br>IS -10000, BS- 5514, ISO-3046, ISO-8528 and as per standard practice of diesel engine manufacturer's association of USA.<br>Selection, Design and construction of the diesel engine shall be guided by the TAC recommendations. |         |
| 93     | Name of Manufacturer | Bidder to furnish.                                                                                                                                                                                                                                                                                                          |         |
| 94     | Model No             | Bidder to furnish.                                                                                                                                                                                                                                                                                                          |         |
| 95     | Duty                 | Intermittent.<br>However, same shall be capable of operating continuously on full load at the site elevation for a period of six hours.                                                                                                                                                                                     |         |
| 96     | Speed                | 1500 rpm                                                                                                                                                                                                                                                                                                                    |         |
| 97     | Type of cooling      | Bidder to Furnish                                                                                                                                                                                                                                                                                                           |         |
| 98     | Noise                | 105 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                                   |         |
| 99     | Vibration            | As per ISO standard                                                                                                                                                                                                                                                                                                         |         |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| <b>ANNEXURE-2C : DATA SHEET FOR JOCKEY PUMP and DRIVE (MOTOR)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                               |                |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Sl.no.</b>                                                     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>BHEL Requirement</b>                                                                                                       | <b>DETAILS</b> |
| <b>GENERAL DATA</b>                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                               |                |
| 1                                                                 | Service                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Jockey Pump[For Replenishing the level of water in the Hydro Pneumatic tank by supplying water from Fire water storage sump.] |                |
| 2                                                                 | Number of Pumps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Total : 2 Nos.<br>2 Nos. for Jockey Pump[1W+1S] [All Motor Driven]                                                            |                |
| 3                                                                 | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Indoor                                                                                                                        |                |
| 4                                                                 | Duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Intermittent. However pump shall be suitable for continuous operation.                                                        |                |
| 5                                                                 | Drives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Motor                                                                                                                         |                |
| 6                                                                 | Pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Water                                                                                                                         |                |
| 7                                                                 | Fluid temp Deg C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Ambient                                                                                                                       |                |
| <b>PUMP PERFORMANCE &amp; OTHER DETAILS</b>                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                               |                |
| 8                                                                 | Pump Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Horizontal,Centrifugal type                                                                                                   |                |
| 9                                                                 | Design Standard of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | HIS/IS 5120/ Equivalent standard<br>The pumps shall comply with the regulations of Tariff Advisory Committee (TAC).           |                |
| 10                                                                | Rated Flow (m <sup>3</sup> /hr)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 40                                                                                                                            |                |
| 11                                                                | Rated Differential Head (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 120                                                                                                                           |                |
| 12                                                                | Inline with TAC requirement,Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                               |                |
| 13                                                                | Temperature of pumping fluid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Ambient                                                                                                                       |                |
| 14                                                                | Pump Model No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Pump model shall be same for both Motor & Engine driven pump.<br>Bidder to indicate pump model                                |                |
| 15                                                                | No. of Stages of pump                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Bidder To Furnish                                                                                                             |                |
| 16                                                                | Parallel operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes.<br>Load sharing between Pumps:Not exceeding 5% over entire operating range when operating in parallel with other pumps   |                |
| 17                                                                | Rated Speed of Pump (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1500                                                                                                                          |                |
| 18                                                                | Rated speed of Motor (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1500                                                                                                                          |                |
| 19                                                                | Pump Efficiency in %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Bidder To Furnish                                                                                                             |                |
| 20                                                                | Available Pressure at centre line of Suction nozzle of Pump mlc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1.0 kg/cm <sup>2</sup> (a)                                                                                                    |                |
| 21                                                                | NPSH(A) at pump suction nozzle (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 10.0 m                                                                                                                        |                |
| 22                                                                | NPSH(R) (mlc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bidder to furnish.                                                                                                            |                |
| 23                                                                | NPSH(A) - NPSH(R)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 m at rated condition & NPSHR shall be less than NPSHA upto end of the curve condition.                                      |                |
| 24                                                                | Pump shut off head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Flow vs Head curve shall be continuously rising towards shut-off head.                                                        |                |
| 25                                                                | Pump shut off head/rated head.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Shall not be exceed 120% of rated head as per TAC.                                                                            |                |
| 26                                                                | BEP of the offered pump, m3/Hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                             |                |
| 27                                                                | Thermal minimum flow , m3/Hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                             |                |
| 28                                                                | Stable minimum flow, m3/Hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Bidder To Furnish                                                                                                             |                |
| 29                                                                | Pump End of the curve flow, m3/hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bidder To Furnish                                                                                                             |                |
| 30                                                                | Impeller type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bidder To Furnish                                                                                                             |                |
| 31                                                                | Pump rated impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                             |                |
| 32                                                                | Pump max. impeller dia, mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Bidder To Furnish                                                                                                             |                |
| 33                                                                | Pump minimum impeller dia., mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder To Furnish                                                                                                             |                |
| 34                                                                | Material of Construction:<br>Casing : 2.5% Ni CI as per IS:210 Gr. FG 260<br>Casing Liner : 2.5% Ni CI as per IS:210 Gr. FG 260<br>Impeller : ASTM - A 743 GR. CF 8 M<br>Wearing rings : SS-304<br>Pump Shaft: AISI 410 (Hardened)<br>Coupling: SS316<br>Base plate : Carbon steel as per IS-2062<br>Wetter Fasteners: SS-316<br>Mechanical Seal: As per Manufacturer's Standard<br>Companion Flange : Carbon Steel as per IS-2062<br>Note: Bidder to confirm that the casing material mentioned above shall cater to the max. discharge pressure(i.e Pressure at shut off condition + maximum suction pressure) including all tolerance.If not, bidder to consider superior material of casing. |                                                                                                                               |                |
| 35                                                                | Sealing arrangement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Mechanical seal as per Manufacturer's Standard                                                                                |                |
| 36                                                                | Flushing Plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bidder To Furnish                                                                                                             |                |
| 37                                                                | Cooling Plan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                             |                |

**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no                                                                                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                          | BHEL Requirement                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DETAILS |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 38                                                                                             | Vendor shall clearly indicate the type of cooling system adopted. In case water is used as a cooling media [for pump/motor] by tapping of the water from the pump discharge (before the pump discharge valve), the capacity of the pump shall be increased, so that the net capacity meets the specification requirement.. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 39                                                                                             | Type of axial thrust balancing arrangement                                                                                                                                                                                                                                                                                                                                                                                           | Vendor shall clearly indicate the type of cooling system adopted. In                                                                                                                                                                                                                                                                                                                                                                                                   |         |
| 40                                                                                             | Type of main bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                       | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 41                                                                                             | Main bearings lubrication                                                                                                                                                                                                                                                                                                                                                                                                            | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 42                                                                                             | Type of thrust bearings for pump                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 43                                                                                             | Thrust bearing lubrication                                                                                                                                                                                                                                                                                                                                                                                                           | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 44                                                                                             | Direction of rotation of Pump                                                                                                                                                                                                                                                                                                                                                                                                        | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 45                                                                                             | Direction of rotation of Motor                                                                                                                                                                                                                                                                                                                                                                                                       | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 46                                                                                             | Direction of rotation of Engine                                                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Furnish                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |
| <b>COUPLING</b>                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 47                                                                                             | Coupling standard                                                                                                                                                                                                                                                                                                                                                                                                                    | Manufacturer Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |
| 48                                                                                             | Type of coupling                                                                                                                                                                                                                                                                                                                                                                                                                     | Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer [The spacer length shall permit removal of the coupling, bearings, seal and rotor, as applicable, without disturbing the driver or the suction and discharge piping].                                                                                                                                                                               |         |
| 49                                                                                             | Non sparking type couplign guard                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| 50                                                                                             | Service factor for the coupling                                                                                                                                                                                                                                                                                                                                                                                                      | 1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| <b>PERFORMANCE TEST STANDARD FOR PUMPS</b>                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 51                                                                                             | Performance test standard                                                                                                                                                                                                                                                                                                                                                                                                            | The testing Standards of the Pumps shall conform to the standards as indicated in TAC recommendation.<br>Performance tolerance shall be as mentioned below:<br>a) Rated head at rated flow: Zero negative tolerance<br>b) Shut-off head: Zero negative tolerance. 5% Positive tolerance permitted.<br>c) Rated BKW: Positive tolerance permitted till selected motor rating meets end of the curve condition<br>d) Efficiency at rated capacity: No negative tolerance |         |
| 52                                                                                             | Maximum Allowed Working Pressure (MAWP) in Kg/cm <sup>2</sup> g                                                                                                                                                                                                                                                                                                                                                                      | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 53                                                                                             | Hydraulic test pressure of casing Kg/cm <sup>2</sup> (g)                                                                                                                                                                                                                                                                                                                                                                             | Hydraulic test pressure of casing shall be 1.5 times the MAWP.Test duration shall be minimum 60 min.                                                                                                                                                                                                                                                                                                                                                                   |         |
| 55                                                                                             | Noise level for Pump                                                                                                                                                                                                                                                                                                                                                                                                                 | 85 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                                                                                                                                                                                                               |         |
| 56                                                                                             | Vibration for Pump                                                                                                                                                                                                                                                                                                                                                                                                                   | As ISO 10816                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |
| 57                                                                                             | Pump Instruments                                                                                                                                                                                                                                                                                                                                                                                                                     | Pressure Gauge at suction and Discharge                                                                                                                                                                                                                                                                                                                                                                                                                                |         |
| <b>PUMP TERMINAL POINT DETAILS</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 58                                                                                             | Pump Suction nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                    | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 59                                                                                             | Pump Discharge nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                                                                  | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 60                                                                                             | Vent/Drain connection:<br>1.Vent with 3 way SS isolating valve<br>2.Drain connection with valve<br>3.Priming connection with 3 way SS isolating valve                                                                                                                                                                                                                                                                                | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| <b>MOTOR DETAILS FOR MOTOR DRIVEN PUMPS [For More Details Please refer enclosed annexures]</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| 61                                                                                             | Drive/Installation                                                                                                                                                                                                                                                                                                                                                                                                                   | Motor/Horizontal                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |
| 62                                                                                             | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                                                               | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 63                                                                                             | BKW at end of curve                                                                                                                                                                                                                                                                                                                                                                                                                  | Bidder To Indicate                                                                                                                                                                                                                                                                                                                                                                                                                                                     |         |
| 64                                                                                             | Selected drive rating in kW:<br>Continuous drive motor rating (at 50 degree C ambient) shall be higher of the following two conditions:<br>i) 115% of the duty point power requirement.<br>ii) Motor input power required at end of curve                                                                                                                                                                                            | Bidder to mention motor kW rating for the motor duly taking care of requirements.                                                                                                                                                                                                                                                                                                                                                                                      |         |
| 65                                                                                             | Design Standard of Motor                                                                                                                                                                                                                                                                                                                                                                                                             | IS 325, IS-12615, IEC-60034                                                                                                                                                                                                                                                                                                                                                                                                                                            |         |



**PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA**  
**CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)**  
**CONSULTANT : TATA CONSULTING ENGINEERS LTD.**

| Sl.no. | Description                                          | BHEL Requirement                                                                                                                                                                                                       | DETAILS |
|--------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 66     | Manufacturer                                         | As per attached subvendor list                                                                                                                                                                                         |         |
| 67     | Ambient Temperature                                  | 50 Deg C<br>All motors shall be designed to operate in humid atmosphere with a maximum ambient temperature of 50 Deg C.                                                                                                |         |
| 68     | Area classification for motor                        | Safe Area                                                                                                                                                                                                              |         |
| 69     | Rated Voltage & Frequency                            | 415 V & 50 Hz                                                                                                                                                                                                          |         |
| 70     | Permissible variations in Voltage/Frequency/Combined | Voltage: (+/-)10%<br>Frequency: +3% & -5%<br>Combined: 10% combined variation of voltage and frequency                                                                                                                 |         |
| 71     | No of poles / synchronous speed                      | 4/1500 rpm                                                                                                                                                                                                             |         |
| 72     | Energy efficient class                               | IE3                                                                                                                                                                                                                    |         |
| 73     | Starting Current as % of FLC                         | 600% subject to IS tolerance                                                                                                                                                                                           |         |
| 74     | Method of Starting                                   | AC squirrel cage industrial motors shall be fed at 415V, 3 phase, 50 Hz, with DOL start as applicable.                                                                                                                 |         |
| 75     | Method of cooling                                    | Motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type                                                                      |         |
| 76     | Winding and Insulation                               | All insulated winding shall be of copper.<br>Motors shall have class F insulation but limited to class B temperature rise.<br>Windings shall be impregnated to make them non-hygroscopic and oil resistant.            |         |
| 78     | Space Heater                                         | Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. |         |
| 79     | Degree of protection/Canopy Required                 | IP 55/Yes & to be supplied by bidder                                                                                                                                                                                   |         |
| 80     | TB Short time-Current & Short time-Time              | 50 kA , 0.25 Sec                                                                                                                                                                                                       |         |
| 81     | Cable, Cable glands & Lugs                           | Suitable double compression Nickel plated brass cable glands and Tinned copper lugs to be provided by the bidder.                                                                                                      |         |
| 82     | No. of Starts                                        | Motors shall be capable of three equally spread starts per hour under normal condition or two starts in quick succession from cold                                                                                     |         |
| 83     | Bearing RTDs, Winding RTDs & TGs                     | Not Applicable                                                                                                                                                                                                         |         |
| 84     | Noise                                                | 85 DBA at 1 m distance from motor body, in any direction                                                                                                                                                               |         |
| 85     | Vibration                                            | As per IS standard                                                                                                                                                                                                     |         |

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-3         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                    |                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <p><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1>Annexure-3</h1> <h2>Hydrant/Spray, Booster &amp; Jockey<br/>Pump-Price bid format</h2> |
|                                                                                                                                                                                                                                                    |                                                                                            |

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

| Annexure-3A                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING & SYSTEMS DIVISION<br>RAMACHANDRAPURAM: HYDERABAD - 502 032                                                                                                                                                                        |                                               |                                      |                                          |              |         |
|                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PRICE FORMAT (R00) FOR HYDRANT AND SPRAY PUMP WITH DRIVES ( MOTOR & DIESEL ENGINE)<br>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA<br>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)<br>CONSULTANT : TATA CONSULTING ENGINEERS LTD. |                                               |                                      |                                          |              |         |
| SL NO                                                                                                                                                                                  | ITEM DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | QTY                                                                                                                                                                                                                                                                                        | UNIT                                          | Weightage w.r.t Overall Price (In %) | Bidder confirmation (Quoted/ Not Quoted) | HSN/SAC Code | GST (%) |
| Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. : <Bidder to indicate><br>BHEL Enq. No. & date :<Bidder to indicate> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| I                                                                                                                                                                                      | MAIN OFFER                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| A                                                                                                                                                                                      | MATERIAL SUPPLY : Motor Driven Hydrant-Spray Pump Assembly [Material code: PY9751464013]                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| A.1                                                                                                                                                                                    | Hydrant and Spray Pump without motor along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                       | 5                                                                                                                                                                                                                                                                                          | Sets                                          | 30.37                                |                                          |              |         |
| B                                                                                                                                                                                      | MATERIAL SUPPLY : Engine Driven Hydrant-Spray Pump Assembly [Material code: PY9751464021]                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| B.1                                                                                                                                                                                    | Hydrant and Spray Pump with diesel engine along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                  | 3                                                                                                                                                                                                                                                                                          | Sets                                          | 60.07                                |                                          |              |         |
| C                                                                                                                                                                                      | MATERIAL SUPPLY: Mandatory spares for Motor/Engine driven Hydrant/Spray Pump Assembly [Material code: PY9751464064] Refer Note-14                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| C.1                                                                                                                                                                                    | Pump-Mandatory spares for Hydrant and spray pump                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                            |                                               | 9.3                                  |                                          |              |         |
|                                                                                                                                                                                        | i)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Set of Impellers                                                                                                                                                                                                                                                                           | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | ii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Set of Shafts                                                                                                                                                                                                                                                                              | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | iii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Casing wear rings                                                                                                                                                                                                                                                                          | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | iv)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Impeller wear rings                                                                                                                                                                                                                                                                        | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | v)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Shaft sleeves                                                                                                                                                                                                                                                                              | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | vi)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Shaft Coupling                                                                                                                                                                                                                                                                             | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | vii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Shaft nut & key                                                                                                                                                                                                                                                                            | 2                                             | Sets                                 |                                          |              |         |
|                                                                                                                                                                                        | viii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Bearing                                                                                                                                                                                                                                                                                    | 2                                             | Sets                                 |                                          |              |         |
| C.2                                                                                                                                                                                    | Engine-Mandatory spares for Hydrant and spray pump                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
|                                                                                                                                                                                        | i)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Element for lub oil Filter                                                                                                                                                                                                                                                                 | 4                                             | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | ii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Element for Fuel Filter                                                                                                                                                                                                                                                                    | 4                                             | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | iii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Outer Element for Air cleaner                                                                                                                                                                                                                                                              | 4                                             | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | iv)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Inner Element for Air cleaner                                                                                                                                                                                                                                                              | 4                                             | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | v)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Turbo-charger                                                                                                                                                                                                                                                                              | 2                                             | No                                   |                                          |              |         |
|                                                                                                                                                                                        | vi)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Engine - starter Motor                                                                                                                                                                                                                                                                     | 2                                             | No                                   |                                          |              |         |
|                                                                                                                                                                                        | vii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Injector                                                                                                                                                                                                                                                                                   | 4                                             | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | viii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Piston rings & liner set                                                                                                                                                                                                                                                                   | 4                                             | Set                                  |                                          |              |         |
| C.3                                                                                                                                                                                    | Panel -Mandatory spares for Hydrant and spray pump                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
|                                                                                                                                                                                        | i)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Push Button-Complete assembly [each color]                                                                                                                                                                                                                                                 | 10 no per each color                          | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | ii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Push Button-Contact Element (1NO + 1NC) Block                                                                                                                                                                                                                                              | 40                                            | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | iii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Selector Switch [each type and rating]                                                                                                                                                                                                                                                     | 20                                            | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | iv)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Voltmeter [each type & Rating]                                                                                                                                                                                                                                                             | Installed qty x 10 % x (2/5) or minimum 2 nos | No                                   |                                          |              |         |
|                                                                                                                                                                                        | v)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Ammeter [each type & Rating]                                                                                                                                                                                                                                                               | Installed qty x 10 % x (2/5) or minimum 2 nos | No                                   |                                          |              |         |
|                                                                                                                                                                                        | vi)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Frequency Meter [each type & Rating]                                                                                                                                                                                                                                                       | Installed qty x 10 % x (2/5) or minimum 2 nos | No                                   |                                          |              |         |
|                                                                                                                                                                                        | vii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Indicating Lamps complete assembly [each Colour and type]                                                                                                                                                                                                                                  | 20 no per each color and type                 | Nos                                  |                                          |              |         |
| C.4                                                                                                                                                                                    | Instrumentation -Mandatory spares for Hydrant and spray pump                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
|                                                                                                                                                                                        | i)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Transmitters/ Gauges/Switches etc. along with relevant accessories                                                                                                                                                                                                                         | Installed qty x 10 % x (2/5) or minimum 2 nos | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | ii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Temperature Element (RTD/Thermo-couple) with thermowell                                                                                                                                                                                                                                    | Installed qty x 10 % x (2/5) or minimum 5 nos | Nos                                  |                                          |              |         |
|                                                                                                                                                                                        | iii)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Cables (Control & Instrumentation)                                                                                                                                                                                                                                                         | Installed qty x 10 % x (2/5)                  | Meter                                |                                          |              |         |
| D                                                                                                                                                                                      | Supervison charges for erection & commissioning at site [Material code:PY9851464511]                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
|                                                                                                                                                                                        | Supervision charges for erection & commissioning shall include the following:<br>1. Per diem charge of for supervision of erection & commissioning of Pump/Motor/Diesel Engine/ etc.<br>2. Charges for 1 visit<br>Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11] | 1 Day and 1 Visit                                                                                                                                                                                                                                                                          |                                               | 0.26                                 |                                          |              |         |
|                                                                                                                                                                                        | Grand total price for sl no A, B, C and D<br>(Inclusive of Packing & Forwarding, Frieght and Insurance)                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                            |                                               | 100                                  |                                          |              |         |
| Packing & Forwarding, Frieght, Insurance and GST :                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| (A) For Supply:                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| (i) Packing & Forwarding :                                                                                                                                                             | In bidder scope                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               | Included in basic price              |                                          |              |         |
| (ii) Frieght:                                                                                                                                                                          | In bidder scope                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               | Included in basic price              |                                          |              |         |
| (iii) Insurance:                                                                                                                                                                       | In BHEL scope                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| (iv) GST                                                                                                                                                                               | Extra at actuals                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                            |                                               | Extra at actuals                     |                                          |              |         |
| (v) Any other:                                                                                                                                                                         | shall be included in baisc price of pumps                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                            |                                               | Included in basic price              |                                          |              |         |
| (B) For supervision of E&C:                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                            |                                               |                                      |                                          |              |         |
| (i) GST:                                                                                                                                                                               | Extra at actuals                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                            |                                               | Extra at actuals                     |                                          |              |         |
| (ii) Any other:                                                                                                                                                                        | Included in basic price                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                            |                                               | Included in basic price              |                                          |              |         |

| SL NO                                                                                                                                                                                                                                                                                                                                                                                                                   | ITEM DESCRIPTION                                                                                                                                                                        | QTY | UNIT | Weightage w.r.t Overall Price (In %) | Bidder confirmation (Quoted/ Not Quoted) | HSN/SAC Code | GST (%) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. : <Bidder to indicate><br>BHEL Enq. No. & date : <Bidder to indicate> |     |      |                                      |                                          |              |         |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 1) Bidders should quote the Total Bid Value in both in figures & words in the specified place.                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 2) Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 3) Bidders shall not fill/edit/modify anything else in the Price Bid Format.                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 4) The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) paisa.                                                                                                                                       |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 5) The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight & Insurance Charges, and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.                                                                                                                               |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 6) Evaluation shall be done on the basis of total bid value i.e. the total landed cost to BHEL for this enquiry. Loading (if applicable) shall be added to the Total Bid Value for evaluation purpose.                                                                                                                                                                                                                  |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 7) The bidders will also provide un-priced price format strictly in the BHEL price format given above, in the techno commercial part of their offers. Bid will be rejected if any other price format is used. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.                                                                                                 |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 8) Bidder to quote strictly as per BHEL's NIT requirements.                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 9) Bidder to note that this is a LUMP SUM Turn-Key Order. However                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 10) <b>Main offer (Annexure-3A)</b> consists of those items which will be part of main order after successful bidder is identified. <b>Optional Items (Annexure-3A-I)</b> consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under <b>Main offer</b> and <b>Optional items</b> as per the prescribed format. |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 11) Prices quoted by bidders for items under main offer : SL No.(A+B+C+D) will be considered for evaluation of lowest bidder.                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| For the purpose of tender (L1 bidder evaluation) following shall be noted:                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| Referring to Sl no D- Supervision charges for Pump/Motor/Engine, For the purpose of Quotation, total no of 1 man days for Pump/Motor/Engine will be covered in 1 visit have been considered and payment against Sl.No D above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.                                        |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| Purchase Order for supply of main items, ( A to C) shall be placed by BHEL- PE&SD Hyderabad. For Supervision of E&C, LOI shall be placed by PE&SD and PO By BHEL-Power sector region.                                                                                                                                                                                                                                   |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| However, BHEL reserves the right                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evaluation will be intimated to vendor during technical evaluation(before price bid opening).                                                                                                                                |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (b) To place PO for any of the Optional items with in the contract period.                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validity of the prices till the end of contract period.                                                                                                                                                                                                                                      |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 12.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against sl no A, B & C shall be Weightage w.r.t Overall Prices mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.                                                        |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 12 b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.                                                                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 12 c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection.                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 13 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.                                                                                                                                                      |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 13.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 14)With respect to Mandatory Spares;                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.                                                                                         |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 15) Reference document: <b>PY51464, R00 &amp; annexures.</b>                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 16) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 17) <b>In case the systems are being supplied from outside India</b> , reputed Third Party Inspection like Llyods or equivalent has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.                               |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |

| Annexure-3A-I                                                                     |                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                            |      |                                                |                 |         |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------|-----------------|---------|
|  |                                                                                                                                                                                                                                                                                | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b>                                                                                                                                                                               |      |                                                |                 |         |
|                                                                                   |                                                                                                                                                                                                                                                                                | <b>PRICE FORMAT (R00) FOR HYDRANT AND SPRAY PUMP WITH DRIVES ( MOTOR &amp; DIESEL ENGINE)</b><br><b>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA</b><br><b>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)</b><br><b>CONSULTANT : TATA CONSULTING ENGINEERS LTD.</b> |      |                                                |                 |         |
| SL NO                                                                             | ITEM DESCRIPTION                                                                                                                                                                                                                                                               | QTY                                                                                                                                                                                                                                                                                                                        | UNIT | Bidder confirmation<br>(Quoted/<br>Not Quoted) | HSN/SAC<br>Code | GST (%) |
|                                                                                   | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. :<Bidder to indicate><br>BHEL Enq. No. & date :<Bidder to indicate>                                                                                          |                                                                                                                                                                                                                                                                                                                            |      |                                                |                 |         |
| <b>II</b>                                                                         | <b>Optional Items</b>                                                                                                                                                                                                                                                          | --                                                                                                                                                                                                                                                                                                                         | --   |                                                |                 |         |
|                                                                                   | <b>2 Years Recommended Spares</b>                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                            |      |                                                |                 |         |
|                                                                                   | Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories.<br><b>(List with price break up to be enclosed)</b><br>(1 set stands for quantity required for the replacement of one pump, drive (or) accessories) | 1 Set                                                                                                                                                                                                                                                                                                                      | Set  |                                                |                 |         |

| Annexure-3B                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |      |                                      |                                          |              |         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING & SYSTEMS DIVISION<br>RAMACHANDRAPURAM: HYDERABAD - 502 032 |      |                                      |                                          |              |         |
| PRICE FORMAT (R00) FOR HYDRANT BOOSTER PUMP WITH DRIVES ( MOTOR & DIESEL ENGINE)<br>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA<br>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)<br>CONSULTANT : TATA CONSULTING ENGINEERS LTD. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |      |                                      |                                          |              |         |
| SL NO                                                                                                                                                                                                                                                                                    | ITEM DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | QTY                                                                                                                 | UNIT | Weightage w.r.t Overall Price (In %) | Bidder confirmation (Quoted/ Not Quoted) | HSN/SAC Code | GST (%) |
|                                                                                                                                                                                                                                                                                          | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. :<Bidder to indicate><br>BHEL Eng. No. & date :<Bidder to indicate>                                                                                                                                                                                                                                                                                               |                                                                                                                     |      |                                      |                                          |              |         |
| I                                                                                                                                                                                                                                                                                        | MAIN OFFER                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                     |      |                                      |                                          |              |         |
| A                                                                                                                                                                                                                                                                                        | MATERIAL SUPPLY : Motor Driven Hydrant Booster Pump Assembly [Material code: PY9751464072]                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                     |      |                                      |                                          |              |         |
| A.1                                                                                                                                                                                                                                                                                      | Hydrant Booster Pump with motor along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                            | 1                                                                                                                   | Set  | 15.58                                |                                          |              |         |
| B                                                                                                                                                                                                                                                                                        | MATERIAL SUPPLY : Engine Driven Hydrant-Spray Pump Assembly [Material code: PY9751464080]                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                     |      |                                      |                                          |              |         |
| B.1                                                                                                                                                                                                                                                                                      | Hydrant Booster Pump with diesel engine along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                    | 1                                                                                                                   | Set  | 43.8                                 |                                          |              |         |
| C                                                                                                                                                                                                                                                                                        | MATERIAL SUPPLY: Mandatory spares for Motor/Engine driven Hydrant Booster Pump Assembly [Material code: PY9751464137]. Refer Note-14                                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |      |                                      |                                          |              |         |
| C.1                                                                                                                                                                                                                                                                                      | Pump-Mandatory spares for Hydrant Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      | 39.52                                |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                       | Set of Impellers                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                      | Set of Shafts                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                     | Casing wear rings                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                      | Impeller wear rings                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                       | Shaft sleeves                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                      | Shaft Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| vii)                                                                                                                                                                                                                                                                                     | Shaft nut & key                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| viii)                                                                                                                                                                                                                                                                                    | Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| C.3-A                                                                                                                                                                                                                                                                                    | Motor-Mandatory spares for Hydrant Booster Pump [above 30 kW]                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                       | End Shield Cover Driving & Non-Driving End                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2 Sets for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                      | Driving End & Non-Driving End Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2 Sets for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                     | Cooling Fan                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2 Nos. for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                      | Motor Space Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2 Nos. for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                       | Motor Terminal Block                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2 Nos. for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                      | Complete Set of Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2 Sets for each Application                                                                                         |      |                                      |                                          |              |         |
| C.3-B                                                                                                                                                                                                                                                                                    | Motor-Mandatory spares for Hydrant Booster Pump [up to 30 kW]                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                       | Driving End & Non-Driving End Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6 Sets for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                      | Cooling Fan                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4 Nos for each type and rating of Motor                                                                             |      |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                     | Motor Terminal Block                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10 Nos for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                      | Complete Set of Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2 Sets for each Application                                                                                         |      |                                      |                                          |              |         |
| C.3                                                                                                                                                                                                                                                                                      | Engine-Mandatory spares for Hydrant Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                       | Element for lub oil Filter                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                      | Element for Fuel Filter                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                     | Outer Element for Air cleaner                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                      | Inner Element for Air cleaner                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                       | Turbo-charger                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | No   |                                      |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                      | Engine - starter Motor                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2                                                                                                                   | No   |                                      |                                          |              |         |
| vii)                                                                                                                                                                                                                                                                                     | Injector                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| viii)                                                                                                                                                                                                                                                                                    | Piston rings & liner set                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4                                                                                                                   | Set  |                                      |                                          |              |         |
| C.3                                                                                                                                                                                                                                                                                      | Panel -Mandatory spares for Hydrant Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                       | Push Button-Complete assembly [each color]                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10 no per each color                                                                                                | Nos  |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                      | Push Button-Contact Element (1NO + 1NC) Block                                                                                                                                                                                                                                                                                                                                                                                                                                       | 40                                                                                                                  | Nos  |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                     | Selector Switch [each type and rating]                                                                                                                                                                                                                                                                                                                                                                                                                                              | 20                                                                                                                  | Nos  |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                      | Voltmeter [each type & Rating]                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | No                                   |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                       | Ammeter [each type & Rating]                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | No                                   |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                      | Frequency Meter [each type & Rating]                                                                                                                                                                                                                                                                                                                                                                                                                                                | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | No                                   |                                          |              |         |
| vii)                                                                                                                                                                                                                                                                                     | Indicating Lamps complete assembly [each Colour and type]                                                                                                                                                                                                                                                                                                                                                                                                                           | 20 no per each color and type                                                                                       |      | Nos                                  |                                          |              |         |
| C.4                                                                                                                                                                                                                                                                                      | Instrumentation -Mandatory spares for Hydrant Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                       | Transmitters/ Gauges/Switches etc. along with relevant accessories                                                                                                                                                                                                                                                                                                                                                                                                                  | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | Nos                                  |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                      | Temperature Element (RTD/Thermo-couple) with thermowell                                                                                                                                                                                                                                                                                                                                                                                                                             | Installed qty x 10 % x (2/5) or minimum 5 nos                                                                       |      | Nos                                  |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                     | Cables (Control & Instrumentation)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Installed qty x 10 % x (2/5)                                                                                        |      | Meter                                |                                          |              |         |
| D                                                                                                                                                                                                                                                                                        | Supervision charges for erection & commissioning at site [Material code:PY9851464520]                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                     |      |                                      |                                          |              |         |
|                                                                                                                                                                                                                                                                                          | Supervision charges for erection & commissioning shall include the following:<br>1. Per diem charge of for supervision of erection & commissioning of Pump/Motor/Diesel Engine/ etc.<br>2. Charges for 1 visit<br>Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11] |                                                                                                                     |      | 1.1                                  |                                          |              |         |
|                                                                                                                                                                                                                                                                                          | 1 Day and 1 Visit                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                     |      |                                      |                                          |              |         |
|                                                                                                                                                                                                                                                                                          | Grand total price for sl no A, B, C and D<br>(Inclusive of Packing & Forwarding, Frieght and Insurance)                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     |      | 100                                  |                                          |              |         |

| SL NO                                                                                                                                                                                                                                                                                                                                                                                                                   | ITEM DESCRIPTION                                                                                                                                                                        | QTY | UNIT | Weightage w.r.t Overall Price (In %) | Bidder confirmation (Quoted/ Not Quoted) | HSN/SAC Code | GST (%) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                                                         | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. : <Bidder to indicate><br>BHEL Enq. No. & date : <Bidder to indicate> |     |      |                                      |                                          |              |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Packing &amp; Forwarding, Freight, Insurance and GST :</b>                                                                                                                           |     |      |                                      |                                          |              |         |
| <b>(A) For Supply:</b>                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (i) Packing & Forwarding                                                                                                                                                                                                                                                                                                                                                                                                | In bidder scope                                                                                                                                                                         |     |      | Included in basic price              |                                          |              |         |
| (ii) Freight:                                                                                                                                                                                                                                                                                                                                                                                                           | In bidder scope                                                                                                                                                                         |     |      | Included in basic price              |                                          |              |         |
| (iii) Insurance:                                                                                                                                                                                                                                                                                                                                                                                                        | In BHEL scope                                                                                                                                                                           |     |      | 1                                    |                                          |              |         |
| (iv) GST                                                                                                                                                                                                                                                                                                                                                                                                                | Extra at actuals                                                                                                                                                                        |     |      | Extra at actuals                     |                                          |              |         |
| (v) Any other:                                                                                                                                                                                                                                                                                                                                                                                                          | shall be included in basic price of pumps                                                                                                                                               |     |      | Included in basic price              |                                          |              |         |
| <b>(B) For supervision of E&amp;C:</b>                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (i) GST:                                                                                                                                                                                                                                                                                                                                                                                                                | Extra at actuals                                                                                                                                                                        |     |      | Extra at actuals                     |                                          |              |         |
| (ii) Any other:                                                                                                                                                                                                                                                                                                                                                                                                         | Included in basic price                                                                                                                                                                 |     |      | Included in basic price              |                                          |              |         |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 1) Bidders should quote the Total Bid Value in both in figures & words in the specified place.                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 2) Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 3) Bidders shall not fill/edit/modify anything else in the Price Bid Format.                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 4) The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) paisa.                                                                                                                                       |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 5) The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight & Insurance Charges, and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.                                                                                                                               |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 6) Evaluation shall be done on the basis of total bid value i.e. the total landed cost to BHEL for this enquiry. Loading (if applicable) shall be added to the Total Bid Value for evaluation purpose.                                                                                                                                                                                                                  |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 7) The bidders will also provide un-priced price format strictly in the BHEL price format given above, in the techno commercial part of their offers. Bid will be rejected if any other price format is used. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.                                                                                                 |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 8) Bidder to quote strictly as per BHEL's NIT requirements.                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 9) Bidder to note that this is a LUMP SUM Turn-Key Order. However                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 10) <b>Main offer (Annexure-3B)</b> consists of those items which will be part of main order after successful bidder is identified. <b>Optional Items (Annexure-3B-I)</b> consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under <b>Main offer</b> and <b>Optional items</b> as per the prescribed format. |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 11) Prices quoted by bidders for items under main offer : Sl. No.(A+B+C+D) will be considered for evaluation of lowest bidder.                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| For the purpose of tender (L1 bidder evaluation) following shall be noted:                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| Referring to Sl no D- Supervision charges for Pump/Motor/Engine, For the purpose of Quotation, total no of 1 man days for Pump/Motor/Engine will be covered in 1 visit have been considered and payment against Sl.No D above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.                                        |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| Purchase Order for supply of main items, ( A to C) shall be placed by BHEL- PE&SD Hyderabad. For Supervision of E&C, LOI shall be placed by PE&SD and PO By BHEL-Power sector region.                                                                                                                                                                                                                                   |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| However, BHEL reserves the right                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evaluation will be intimated to vendor during technical evaluation(before price bid opening).                                                                                                                                |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (b) To place PO for any of the Optional items with in the contract period.                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validity of the prices till the end of contract period.                                                                                                                                                                                                                                      |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 12.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against sl no A, B & C shall be Weightage w.r.t Overall Prices mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.                                                        |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 12 b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.                                                                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 12 c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection.                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 13 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.                                                                                                                                                      |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 13.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 14)With respect to Mandatory Spares;                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.                                                                                                                                                                                                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.                                                                                         |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 15) Reference document: <b>PY51464, R00 &amp; annexures.</b>                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 16) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.                           |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| 17) <b>In case the systems are being supplied from outside India</b> , reputed Third Party Inspection like Llyods or equivalent has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.                               |                                                                                                                                                                                         |     |      |                                      |                                          |              |         |



| Annexure-3B-I                                                                     |                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                                |              |         |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------|--------------|---------|
|  |                                                                                                                                                                                                                                                                                | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b>                                                                                                                                                                             |      |                                                |              |         |
|                                                                                   |                                                                                                                                                                                                                                                                                | <b>PRICE FORMAT (R00) FOR HYDRANT BOOSTER PUMP WITH DRIVES ( MOTOR &amp; DIESEL ENGINE)</b><br><b>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA</b><br><b>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)</b><br><b>CONSULTANT : TATA CONSULTING ENGINEERS LTD.</b> |      |                                                |              |         |
| SL NO                                                                             | ITEM DESCRIPTION                                                                                                                                                                                                                                                               | QTY                                                                                                                                                                                                                                                                                                                      | UNIT | Bidder confirmation<br>(Quoted/<br>Not Quoted) | HSN/SAC Code | GST (%) |
|                                                                                   | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. :<Bidder to indicate><br>BHEL Enq. No. & date :<Bidder to indicate>                                                                                          |                                                                                                                                                                                                                                                                                                                          |      |                                                |              |         |
| <b>II</b>                                                                         | <b>Optional Items</b>                                                                                                                                                                                                                                                          | --                                                                                                                                                                                                                                                                                                                       | --   |                                                |              |         |
|                                                                                   | <b>2 Years Recommended Spares</b>                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                          |      |                                                |              |         |
|                                                                                   | Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories.<br><b>(List with price break up to be enclosed)</b><br>(1 set stands for quantity required for the replacement of one pump, drive (or) accessories) | 1 Set                                                                                                                                                                                                                                                                                                                    | Set  |                                                |              |         |

| Annexure-3C                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |      |                                      |                                          |              |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING & SYSTEMS DIVISION<br>RAMACHANDRAPURAM: HYDERABAD - 502 032 |      |                                      |                                          |              |         |
| PRICE FORMAT (R00) FOR SPRAY BOOSTER PUMP WITH DRIVES ( MOTOR & DIESEL ENGINE)<br>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA<br>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)<br>CONSULTANT : TATA CONSULTING ENGINEERS LTD. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |      |                                      |                                          |              |         |
| SL NO                                                                                                                                                                                                                                                                                  | ITEM DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | QTY                                                                                                                 | UNIT | Weightage w.r.t Overall Price (In %) | Bidder confirmation (Quoted/ Not Quoted) | HSN/SAC Code | GST (%) |
|                                                                                                                                                                                                                                                                                        | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. :<Bidder to indicate><br>BHEL Eng. No. & date :<Bidder to indicate>                                                                                                                                                                                                                                                                                               |                                                                                                                     |      |                                      |                                          |              |         |
| I                                                                                                                                                                                                                                                                                      | MAIN OFFER                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                     |      |                                      |                                          |              |         |
| A                                                                                                                                                                                                                                                                                      | MATERIAL SUPPLY : Motor Driven Spray Booster Pump Assembly [Material code: PY9751464145]                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                     |      |                                      |                                          |              |         |
| A.1                                                                                                                                                                                                                                                                                    | Spray Booster Pump with motor along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                              | 1                                                                                                                   | Sets | 17.65                                |                                          |              |         |
| B                                                                                                                                                                                                                                                                                      | MATERIAL SUPPLY : Engine Driven Spray-Spray Pump Assembly [Material code: PY9751464153]                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     |      |                                      |                                          |              |         |
| B.1                                                                                                                                                                                                                                                                                    | Spray Booster Pump with diesel engine along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                      | 1                                                                                                                   | Sets | 44.67                                |                                          |              |         |
| C                                                                                                                                                                                                                                                                                      | MATERIAL SUPPLY: Mandatory spares for Motor/Engine driven Spray Booster Pump Assembly [Material code: PY9751464200] Refer Note-14                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                     |      |                                      |                                          |              |         |
| C.1                                                                                                                                                                                                                                                                                    | Pump-Mandatory spares for Spray Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                     |      | 36.81                                |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                     | Set of Impellers                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                    | Set of Shafts                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                   | Casing wear rings                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                    | Impeller wear rings                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                     | Shaft sleeves                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                    | Shaft Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| vii)                                                                                                                                                                                                                                                                                   | Shaft nut & key                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| viii)                                                                                                                                                                                                                                                                                  | Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2                                                                                                                   | Sets |                                      |                                          |              |         |
| C.3-A                                                                                                                                                                                                                                                                                  | Motor-Mandatory spares for Spray Booster Pump [above 30 kW]                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                     | End Shield Cover Driving & Non-Driving End                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2 Sets for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                    | Driving End & Non-Driving End Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2 Sets for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                   | Cooling Fan                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2 Nos. for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                    | Motor Space Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2 Nos. for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                     | Motor Terminal Block                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2 Nos. for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                    | Complete Set of Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2 Sets for each Application                                                                                         |      |                                      |                                          |              |         |
| C.3-B                                                                                                                                                                                                                                                                                  | Motor-Mandatory spares for Spray Booster Pump [up to 30 kW]                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                     | Driving End & Non-Driving End Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6 Sets for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                    | Cooling Fan                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4 Nos for each type and rating of Motor                                                                             |      |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                   | Motor Terminal Block                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10 Nos for each type and rating of Motor                                                                            |      |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                    | Complete Set of Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2 Sets for each Application                                                                                         |      |                                      |                                          |              |         |
| C.3                                                                                                                                                                                                                                                                                    | Engine-Mandatory spares for Spray Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                     | Element for lub oil Filter                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                    | Element for Fuel Filter                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                   | Outer Element for Air cleaner                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                    | Inner Element for Air cleaner                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                     | Turbo-charger                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | No   |                                      |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                    | Engine - starter Motor                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2                                                                                                                   | No   |                                      |                                          |              |         |
| vii)                                                                                                                                                                                                                                                                                   | Injector                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4                                                                                                                   | Nos  |                                      |                                          |              |         |
| viii)                                                                                                                                                                                                                                                                                  | Piston rings & liner set                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4                                                                                                                   | Set  |                                      |                                          |              |         |
| C.3                                                                                                                                                                                                                                                                                    | Panel -Mandatory spares for Spray Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                     | Push Button-Complete assembly [each color]                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10 no per each color                                                                                                | Nos  |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                    | Push Button-Contact Element (1NO + 1NC) Block                                                                                                                                                                                                                                                                                                                                                                                                                                       | 40                                                                                                                  | Nos  |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                   | Selector Switch [each type and rating]                                                                                                                                                                                                                                                                                                                                                                                                                                              | 20                                                                                                                  | Nos  |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                    | Voltmeter [each type & Rating]                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | No                                   |                                          |              |         |
| v)                                                                                                                                                                                                                                                                                     | Ammeter [each type & Rating]                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | No                                   |                                          |              |         |
| vi)                                                                                                                                                                                                                                                                                    | Frequency Meter [each type & Rating]                                                                                                                                                                                                                                                                                                                                                                                                                                                | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | No                                   |                                          |              |         |
| vii)                                                                                                                                                                                                                                                                                   | Indicating Lamps complete assembly [each Colour and type]                                                                                                                                                                                                                                                                                                                                                                                                                           | 20 no per each color and type                                                                                       |      | Nos                                  |                                          |              |         |
| C.4                                                                                                                                                                                                                                                                                    | Instrumentation -Mandatory spares for Spray Booster Pump                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                     |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                     | Transmitters/ Gauges/Switches etc. along with relevant accessories                                                                                                                                                                                                                                                                                                                                                                                                                  | Installed qty x 10 % x (2/5) or minimum 2 nos                                                                       |      | Nos                                  |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                    | Temperature Element (RTD/Thermo-couple) with thermowell                                                                                                                                                                                                                                                                                                                                                                                                                             | Installed qty x 10 % x (2/5) or minimum 5 nos                                                                       |      | Nos                                  |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                   | Cables (Control & Instrumentation)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Installed qty x 10 % x (2/5)                                                                                        |      | Meter                                |                                          |              |         |
| D                                                                                                                                                                                                                                                                                      | Supervision charges for erection & commissioning at site [Material code:PY9851464538]                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                     |      |                                      |                                          |              |         |
|                                                                                                                                                                                                                                                                                        | Supervision charges for erection & commissioning shall include the following:<br>1. Per diem charge of for supervision of erection & commissioning of Pump/Motor/Diesel Engine/ etc.<br>2. Charges for 1 visit<br>Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11] | 1 Day and 1 Visit                                                                                                   |      | 0.87                                 |                                          |              |         |
|                                                                                                                                                                                                                                                                                        | Grand total price for sl no A, B, C and D<br>(Inclusive of Packing & Forwarding, Freight and Insurance)                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     |      | 100                                  |                                          |              |         |

| SL NO                                                                                                                                                                                                                                                                                                                                                                                         | ITEM DESCRIPTION                                                                                                                                                                      | QTY | UNIT | Weightage w.r.t Overall Price (In %) | Bidder confirmation (Quoted/ Not Quoted) | HSN/SAC Code | GST (%) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                               | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. :<Bidder to indicate><br>BHEL Enq. No. & date :<Bidder to indicate> |     |      |                                      |                                          |              |         |
| Packing & Forwarding, Freight, Insurance and GST :                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (A) For Supply:                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (i) Packing & Forwarding                                                                                                                                                                                                                                                                                                                                                                      | In bidder scope                                                                                                                                                                       |     |      | Included in basic price              |                                          |              |         |
| (ii) Frieght:                                                                                                                                                                                                                                                                                                                                                                                 | In bidder scope                                                                                                                                                                       |     |      | Included in basic price              |                                          |              |         |
| (iii) Insurance:                                                                                                                                                                                                                                                                                                                                                                              | In BHEL scope                                                                                                                                                                         |     |      |                                      |                                          |              |         |
| (iv) GST                                                                                                                                                                                                                                                                                                                                                                                      | Extra at actuals                                                                                                                                                                      |     |      | Extra at actuals                     |                                          |              |         |
| (v) Any other:                                                                                                                                                                                                                                                                                                                                                                                | shall be included in baisc price of pumps                                                                                                                                             |     |      | Included in basic price              |                                          |              |         |
| (B) For supervision of E&C:                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (i) GST:                                                                                                                                                                                                                                                                                                                                                                                      | Extra at actuals                                                                                                                                                                      |     |      | Extra at actuals                     |                                          |              |         |
| (ii) Any other:                                                                                                                                                                                                                                                                                                                                                                               | Included in basic price                                                                                                                                                               |     |      | Included in basic price              |                                          |              |         |
| Notes:                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 1) Bidders should quote the Total Bid Value in both in figures & words in the specified place.                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 2) Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 3) Bidders shall not fill/edit/modify anything else in the Price Bid Format.                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 4) The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) paisa.                                                                                                             |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 5) The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight & Insurance Charges, and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.                                                                                                     |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 6) Evaluation shall be done on the basis of total bid value i.e. the total landed cost to BHEL for this enquiry. Loading (if applicable) shall be added to the Total Bid Value for evaluation purpose.                                                                                                                                                                                        |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 7) The bidders will also provide un-priced price format strictly in the BHEL price format given above, in the techno commercial part of their offers. Bid will be rejected if any other price format is used. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.                                                                       |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 8) Bidder to quote strictly as per BHEL's NIT requirements.                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 9) Bidder to note that this is a LUMP SUM Turn-Key Order. However                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.                                                                                                                                                                                  |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 10) Main offer (Annexure-3B) consists of those items which will be part of main order after successful bidder is identified. Optional Items (Annexure-3B-I) consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format.   |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 11) Prices quoted by bidders for items under main offer : SL No.(A+B+C+D) will be considered for evaluation of lowest bidder.                                                                                                                                                                                                                                                                 |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| For the purpose of tender (L1 bidder evaluation) following shall be noted:                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| Referring to SL no D- Supervision charges for Pump/Motor/Engine, For the purpose of Quotation, total no of 1 man days for Pump/Motor/Engine will be covered in 1 visit have been considered and payment against SL.No D above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.              |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| Purchase Order for supply of main items, ( A to C) shall be placed by BHEL- PE&SD Hyderabad. For Supervisionof E&C, LOI shall be placed by PE&SD and PO By BHEL-Power sector region.                                                                                                                                                                                                          |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| However, BHEL reserves the right                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evaluation will be intimated to vendor during technical evaluation(before price bid opening).                                                                                                      |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| (b) To place PO for any of the Optional items with in the contract period.                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validity of the prices till the end of contract period.                                                                                                                                                                                                            |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 12.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against sl no A, B & C shall be Weightage w.r.t Overall Prices mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.                              |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 12 b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.                                                                                                                                                                                                                                  |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 12 c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection.                                                                                                                                                                                                                                                                        |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 13 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.                                                                                                                            |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 13.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.                                                                                                                                                                                                                          |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 14)With respect to Mandatory Spares;                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.                                                                                                                                                                                 |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.                                                               |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 15) Reference document: PY51464, R00 & annexures.                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 16) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format. |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |
| 17) In case the systems are being supplied from outside India, reputed Third Party Inspection like Llyods or equivalent has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.             |                                                                                                                                                                                       |     |      |                                      |                                          |              |         |

| Annexure-3C-I                                                                     |                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                        |      |                                                |                 |         |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------|-----------------|---------|
|  |                                                                                                                                                                                                                                                                                | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b>                                                                                                                                                                           |      |                                                |                 |         |
|                                                                                   |                                                                                                                                                                                                                                                                                | <b>PRICE FORMAT (R00) FOR SPRAY BOOSTER PUMP WITH DRIVES ( MOTOR &amp; DIESEL ENGINE)</b><br><b>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA</b><br><b>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)</b><br><b>CONSULTANT : TATA CONSULTING ENGINEERS LTD.</b> |      |                                                |                 |         |
| SL NO                                                                             | ITEM DESCRIPTION                                                                                                                                                                                                                                                               | QTY                                                                                                                                                                                                                                                                                                                    | UNIT | Bidder confirmation<br>(Quoted/<br>Not Quoted) | HSN/SAC<br>Code | GST (%) |
|                                                                                   | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. : <Bidder to indicate><br>BHEL Enq. No. & date : <Bidder to indicate>                                                                                        |                                                                                                                                                                                                                                                                                                                        |      |                                                |                 |         |
| <b>II</b>                                                                         | <b>Optional Items</b>                                                                                                                                                                                                                                                          | --                                                                                                                                                                                                                                                                                                                     | --   |                                                |                 |         |
|                                                                                   | <b>2 Years Recommended Spares</b>                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                        |      |                                                |                 |         |
|                                                                                   | Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories.<br><b>(List with price break up to be enclosed)</b><br>(1 set stands for quantity required for the replacement of one pump, drive (or) accessories) | 1 Set                                                                                                                                                                                                                                                                                                                  | Set  |                                                |                 |         |

| Annexure-3D                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------|---------------------------------------------------|-----------------|---------|
|                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BHARAT HEAVY ELECTRICALS LIMITED<br>PROJECT ENGINEERING & SYSTEMS DIVISION<br>RAMACHANDRAPURAM: HYDERABAD - 502 032 |      |                                               |                                                   |                 |         |
| PRICE FORMAT (R00) FOR JOCKEY PUMP WITH DRIVES ( MOTOR)<br>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA<br>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)<br>CONSULTANT : TATA CONSULTING ENGINEERS LTD.                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| SL NO                                                                                                                                                                                                                                                                                                                                                                                       | ITEM DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                     | QTY                                                                                                                 | UNIT | Weightage<br>w.r.t<br>Overall Price<br>(In %) | Bidder<br>confirmation<br>(Quoted/<br>Not Quoted) | HSN/SAC<br>Code | GST (%) |
|                                                                                                                                                                                                                                                                                                                                                                                             | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. :<Bidder to indicate><br>BHEL Eng. No. & date :<Bidder to indicate>                                                                                                                                                                                                                                                                                |                                                                                                                     |      |                                               |                                                   |                 |         |
| I                                                                                                                                                                                                                                                                                                                                                                                           | MAIN OFFER                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                     |      |                                               |                                                   |                 |         |
| A                                                                                                                                                                                                                                                                                                                                                                                           | MATERIAL SUPPLY : Motor Driven Jockey Pump Assembly [Material code: PY9751464218]                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                     |      |                                               |                                                   |                 |         |
|                                                                                                                                                                                                                                                                                                                                                                                             | Jockey Pump with motor along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                      | 2                                                                                                                   | Sets | 73.68                                         |                                                   |                 |         |
| B                                                                                                                                                                                                                                                                                                                                                                                           | MATERIAL SUPPLY: Mandatory spares for Motor driven Jockey Pump Assembly [Material code: PY9751464250] Refer Note-14                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                     |      |                                               |                                                   |                 |         |
| B.1                                                                                                                                                                                                                                                                                                                                                                                         | Pump-Mandatory spares for Jockey Pump                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |      | 23.93                                         |                                                   |                 |         |
| i)                                                                                                                                                                                                                                                                                                                                                                                          | Set of Impellers                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| ii)                                                                                                                                                                                                                                                                                                                                                                                         | Set of Shafts                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| iii)                                                                                                                                                                                                                                                                                                                                                                                        | Casing wear rings                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| iv)                                                                                                                                                                                                                                                                                                                                                                                         | Impeller wear rings                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| v)                                                                                                                                                                                                                                                                                                                                                                                          | Shaft sleeves                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| vi)                                                                                                                                                                                                                                                                                                                                                                                         | Shaft Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| vii)                                                                                                                                                                                                                                                                                                                                                                                        | Shaft nut & key                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| viii)                                                                                                                                                                                                                                                                                                                                                                                       | Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2                                                                                                                   | Sets |                                               |                                                   |                 |         |
| B.2-A                                                                                                                                                                                                                                                                                                                                                                                       | Motor-Mandatory spares for Jockey Pump [above 30 kW]                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                     |      |                                               |                                                   |                 |         |
| i)                                                                                                                                                                                                                                                                                                                                                                                          | End Shield Cover Driving & Non-Driving End                                                                                                                                                                                                                                                                                                                                                                                                                           | 2 Sets for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| ii)                                                                                                                                                                                                                                                                                                                                                                                         | Driving End & Non-Driving End Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                | 2 Sets for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| iii)                                                                                                                                                                                                                                                                                                                                                                                        | Cooling Fan                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2 Nos. for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| iv)                                                                                                                                                                                                                                                                                                                                                                                         | Motor Space Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2 Nos. for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| v)                                                                                                                                                                                                                                                                                                                                                                                          | Motor Terminal Block                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2 Nos. for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| vi)                                                                                                                                                                                                                                                                                                                                                                                         | Complete Set of Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2 Sets for each Application                                                                                         |      |                                               |                                                   |                 |         |
| B.2-B                                                                                                                                                                                                                                                                                                                                                                                       | Motor-Mandatory spares for Jockey Pump [up to 30 kW]                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                     |      |                                               |                                                   |                 |         |
| i)                                                                                                                                                                                                                                                                                                                                                                                          | Driving End & Non-Driving End Bearing                                                                                                                                                                                                                                                                                                                                                                                                                                | 6 Sets for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| ii)                                                                                                                                                                                                                                                                                                                                                                                         | Cooling Fan                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4 Nos for each type and rating of Motor                                                                             |      |                                               |                                                   |                 |         |
| iii)                                                                                                                                                                                                                                                                                                                                                                                        | Motor Terminal Block                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10 Nos for each type and rating of Motor                                                                            |      |                                               |                                                   |                 |         |
| iv)                                                                                                                                                                                                                                                                                                                                                                                         | Complete Set of Coupling                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2 Sets for each Application                                                                                         |      |                                               |                                                   |                 |         |
| C                                                                                                                                                                                                                                                                                                                                                                                           | Supervision charges for erection & commissioning at site [Material code:PY9851464546]                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |      | 2.39                                          |                                                   |                 |         |
|                                                                                                                                                                                                                                                                                                                                                                                             | Supervision charges for erection & commissioning shall include the following:<br>1. Per diem charge of for supervision of erection & commissioning of Pump/Motor etc.<br>2. Charges for 1 visit<br>Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11] | 1 Day and 1 Visit                                                                                                   |      |                                               |                                                   |                 |         |
| Grand total price for sl no A, B and C<br>(Inclusive of Packing & Forwarding, Freight and Insurance)                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      | 100                                           |                                                   |                 |         |
| Packing & Forwarding, Frieght, Insurance and GST :                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (A) For Supply:                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (i) Packing & Forwarding                                                                                                                                                                                                                                                                                                                                                                    | In bidder scope                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      | Included in basic price                       |                                                   |                 |         |
| (ii) Frieght:                                                                                                                                                                                                                                                                                                                                                                               | In bidder scope                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      | Included in basic price                       |                                                   |                 |         |
| (iii) Insurance:                                                                                                                                                                                                                                                                                                                                                                            | In BHEL scope                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                     |      |                                               |                                                   |                 |         |
| (iv) GST                                                                                                                                                                                                                                                                                                                                                                                    | Extra at actuals                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |      | Extra at actuals                              |                                                   |                 |         |
| (v) Any other:                                                                                                                                                                                                                                                                                                                                                                              | shall be included in baisc price of pumps                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                     |      | Included in basic price                       |                                                   |                 |         |
| (B) For supervision of E&C:                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (i) GST:                                                                                                                                                                                                                                                                                                                                                                                    | Extra at actuals                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |      | Extra at actuals                              |                                                   |                 |         |
| (ii) Any other:                                                                                                                                                                                                                                                                                                                                                                             | Included in basic price                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                     |      | Included in basic price                       |                                                   |                 |         |
| Notes:                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 1) Bidders should quote the Total Bid Value in both in figures & words in the specified place.                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 2) Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 3) Bidders shall not fill/edit/modify anything else in the Price Bid Format.                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 4) The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) paisa.                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 5) The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight & Insurance Charges, and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 6) Evaluation shall be done on the basis of total bid value i.e. the total landed cost to BHEL for this enquiry. Loading (if applicable) shall be added to the Total Bid Value for evaluation purpose.                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 7) The bidders will also provide un-priced price format strictly in the BHEL price format given above, in the techno commercial part of their offers. Bid will be rejected if any other price format is used. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 8) Bidder to quote strictly as per BHEL's NIT requirements.                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 9) Bidder to note that this is a LUMP SUM Turn-Key Order. However                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably.                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 10) Main offer (Annexure-3B) consists of those items which will be part of main order after successful bidder is identified. Optional Items (Annexure-3B-I) consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| 11) Prices quoted by bidders for items under main offer : SL No.(A+B+C+D) will be considered for evaluation of lowest bidder.                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| For the purpose of tender (L1 bidder evaluation) following shall be noted:                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| Referring to SL no D- Supervision charges for Pump/Motor etc, For the purpose of Quotation, total no of 1 man days for Pump/Motor etc will be covered in 1 visit have been considered and payment against SLNo D above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| Purchase Order for supply of main items, ( A to C) shall be placed by BHEL- PE&SD Hyderabad. For Supervisionof E&C, LOI shall be placed by PE&SD and PO By BHEL-Power sector region.                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| However, BHEL reserves the right                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evalution will be intimated to vendor during technical evaluation(before price bid opening).                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| (b) To place PO for any of the Optional items with in the contract period.                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |
| Hence bidders need to mandatorily quote reasonable prices for all optional items considering such requirement and keep the validity of the prices till the end of contract period.                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |      |                                               |                                                   |                 |         |

| SL NO | ITEM DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | QTY | UNIT | Weightage<br>w.r.t<br>Overall Price<br>(In %) | Bidder<br>confirmation<br>(Quoted/<br>Not Quoted) | HSN/SAC<br>Code | GST (%) |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----------------------------------------------|---------------------------------------------------|-----------------|---------|
|       | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. : <Bidder to indicate><br>BHEL Enq. No. & date : <Bidder to indicate>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |      |                                               |                                                   |                 |         |
|       | 12.a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against sl no A, B & C shall be Weightage w.r.t Overall Prices mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection.<br>12 b) Bidder must not change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price.<br>12 c) Bidder to quote for all the items as per price bid format. Incomplete/partial offer may be liable for rejection. |     |      |                                               |                                                   |                 |         |
|       | 13 a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidders experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum.<br>13.b) Commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor.                                                                                                                                                                                                                 |     |      |                                               |                                                   |                 |         |
|       | 14)With respect to Mandatory Spares;<br>A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.<br>B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.                                                                   |     |      |                                               |                                                   |                 |         |
|       | 15) Reference document: <b>PY51464, R00 &amp; annexures.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |      |                                               |                                                   |                 |         |
|       | 16) Unpriced price bid format indicating as quoted against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.                                                                                                                                                                                                                                                              |     |      |                                               |                                                   |                 |         |
|       | 17) <b>In case the systems are being supplied from outside India</b> , reputed Third Party Inspection like Llyods or equivalent has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.                                                                                                                                                                                                                                                                  |     |      |                                               |                                                   |                 |         |

| Annexure-3D-I                                                                     |                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                             |      |                                                |                 |         |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------|-----------------|---------|
|  |                                                                                                                                                                                                                                                                                | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b>                                                                                                                                                |      |                                                |                 |         |
|                                                                                   |                                                                                                                                                                                                                                                                                | <b>PRICE FORMAT (R00) FOR JOCKEY PUMP WITH DRIVES ( MOTOR)</b><br><b>PROJECT: 5X800 MW YADADRI THERMAL POWER STATION PROJECT, NALGONDA, TELANGANA</b><br><b>CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD. (TSGENCO)</b><br><b>CONSULTANT : TATA CONSULTING ENGINEERS LTD.</b> |      |                                                |                 |         |
| SL NO                                                                             | ITEM DESCRIPTION                                                                                                                                                                                                                                                               | QTY                                                                                                                                                                                                                                                                                         | UNIT | Bidder confirmation<br>(Quoted/<br>Not Quoted) | HSN/SAC<br>Code | GST (%) |
|                                                                                   | Bidder's Name : <Bidder to indicate><br>Bidder's Offer No. & Dt. : <Bidder to indicate><br>Bidder's Ref No. & Dt. : <Bidder to indicate><br>BHEL Enq. No. & date : <Bidder to indicate>                                                                                        |                                                                                                                                                                                                                                                                                             |      |                                                |                 |         |
| <b>II</b>                                                                         | <b>Optional Items</b>                                                                                                                                                                                                                                                          | --                                                                                                                                                                                                                                                                                          | --   |                                                |                 |         |
|                                                                                   | <b>2 Years Recommended Spares</b>                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                             |      |                                                |                 |         |
|                                                                                   | Recommended spares list for two years normal operation along with unit price breakup for Pump, Drives & other accessories.<br><b>(List with price break up to be enclosed)</b><br>(1 set stands for quantity required for the replacement of one pump, drive (or) accessories) | 1 Set                                                                                                                                                                                                                                                                                       | Set  |                                                |                 |         |

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-4         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                    |                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| <p><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1>Annexure-4</h1> <h2>Hydrant/Spray, Booster &amp; Jockey Pump-Check list</h2> |
|                                                                                                                                                                                                                                                    |                                                                                  |

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |



**ANNEXURE-4A to BHEL Tender Specification:**

**CHECKLIST FOR OFFER FOR HYDRANT AND SPARY PUMP WITH DRIVES (MOTOR/DIESEL ENGINE)**

| S.No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Bidder's Reply |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.    | Bidder to confirm that the following documents are submitted along with their offer to enable BHEL to evaluate the offer.<br>a)Duly filled in Pump-Motor-Diesel Engine datasheet (Annexure-2)<br>b)Tentative GAD for Pump with Motor & Engine<br>c)Performance curves for pump<br>d)T-S curve for main Hydrant-Spray Pumps<br>e)Un-priced copy of price in attached BHEL price bid formats (Annexure-3) indicating quoted/ not quoted against each row & column.<br>f)Equipment qualification criteria / PTR / Reference Lists (Annexure-6)<br>g)Checklist as per (Annexure-4)<br>h) No Deviation Certificate as per (Annexure-10) |                |
| 2.    | All-important documents such as unpriced price bid, reference list, pump performance curve, Pump & drive assembly GA drawings, CS drawings must necessarily to be furnished by bidder along with their offer for evaluation.<br><b>Bidder to once again check their offer before submission and confirm.</b>                                                                                                                                                                                                                                                                                                                       |                |
| 3.    | Scope of supply as per Tender Specification. Bidder to Confirm.<br><b>Further any document indicating scope of supply submitted by bidders shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |
| 4.    | Bidder to confirm that Performance requirement, Design and construction of the offered Pump model shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |
| 5.    | Bidder to confirm that Performance requirement, Design and construction of the offered Diesel Engine shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 6.    | Refer Annexure-2 of Tender Specification: Datasheet of Hydrant/Spray Pump-Motor & Engine Datasheet. Duly filled Annexure-2 is enclosed with bidder's offer as indicated Tender Specification, Bidder to Confirm.<br><b>Datasheets in other formats shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                      |                |
| 7.    | Bidder to confirm that stand mounted DECP along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |
| 8.    | Bidder to confirm that suitable supporting structure for Fuel tank along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |
| 9.    | Bidder to confirm that suitable supporting structure for Battery along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |
| 10.   | Suitable power, control and signal cable with glands & lugs for cable between Control panel, Battery, Battery charger and Diesel Engine shall be included in bidder scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                       |                |
| 11.   | Even though HT motor is not in bidder scope of supply, Bidder to supply suitable Power cable gland and lugs for HT motor. Cable details shall be furnished during detail engineering stage. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                     |                |
| 12.   | Even though HT motor is not in bidder scope of supply, Bidder to provide suitable canopy for each motor.<br>Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |
| 13.   | 1 No. of suitable motor (ex-proof type) operated and 1No. of hand operated barrel pumps are considered by the bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 14. | Minimum instrumentations indicated in Tender Specification, bidder to include it in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 15. | 15 m of exhaust piping with silencer & insulation with 6 Nos. of bends are included in bidder's scope of supply. The exhaust piping shall consist of bends, hood, bird screen etc. Deviation in this is not acceptable. <b>Bidder to Confirm.</b>                                                                                                                                                                                                       |  |
| 16. | Battery [Lead Acid plante type] and battery charger is considered by bidder in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                           |  |
| 17. | Coupling between pump and drives, [Motor/Engine] shall be as per BHEL Tender Specification. Accordingly coupling mandatory spares to be considered as per BHEL Tender Specification. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                            |  |
| 18. | Suitable reducers/expanders & counter flanges along with gaskets & stud nuts at all the terminal points are considered by bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                               |  |
| 19. | <b>Auxiliaries Equipment/Spares:</b> All auxiliary equipment [clause no 7.4.5.7.3 of TAC] & spares [7.4.5.11 of TAC] as per TAC are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                       |  |
| 20. | Bidder to furnish list of commissioning spares as per OEM recommendation. Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                     |  |
| 21. | Bidder to furnish list of special tools & tackles. All the special tools and tackles indicated in tender specification are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                |  |
| 22. | Bidder to furnish list of 2 year recommended spares as per OEM recommendation. Bidder to quote for the same in the price bid as optional price. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 23. | Bidder to meet the Equipment Qualification Criteria. All the references shall be submitted along with the offer as per Annexure-6. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                              |  |
| 24. | Painting schedule shall be as per Annexure-4 of Tender Specification, Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                |  |
| 25. | <b>Inspection, Testing requirements for Pump &amp; Drive assembly:</b><br>Inspection, Testing requirements shall be as per BHEL QAP & specification requirement only. Bidder to note that QAP shall be as per Annexure-7 & the same shall be discussed during detail engg. However in case of practical difficulties in meeting the quality requirement, same shall be mutually discussed & agreed during detail engg. Stage. Bidder to note & confirm. |  |
| 26. | Make of all the items shall be as per Annexure-8 (Sub-Vendor List). Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                  |  |
| 27. | Bidder to confirm compliance with Annexure-9, Master Document List enclosed with Tender Specification, wrt list of documents, schedule of submission.                                                                                                                                                                                                                                                                                                   |  |
| 28. | Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight & Consider the same.                                                                                                                                                                                                                                    |  |
| 29. | Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer. Any deviation/ queries raised during technical bid submission shall not be entertained. Bidder to Confirm.                                                                                                                                                                                  |  |
| 30. | Bidder to quote as per Annexure-3, Price Bid Format only.<br>Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed with bidder's offer. Bidder to check and confirm.                                                                                                                                               |  |
| 31. | Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and confirm.                                                                                                                                                                                                                                                                                                                                           |  |
| 32. | Refer Annexure-2 of Tender Specification. The casing material mentioned in shall cater to the Hydraulic test pressure of                                                                                                                                                                                                                                                                                                                                |  |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|     | casing Kg/cm <sup>2</sup> (g) as mentioned in Annexure 2..If Not, bidder to consider superior material of casing. <b>Bidder to confirm.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 33. | Bidder to provide PLC control Panel for each diesel engine driven pump. Bidder to submit Soft copy and hard copy of logics executed in PLC for uploading the same by end customer later. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 34. | <p><b>Engine rating shall be as mentioned below:</b></p> <p><b>i.</b> The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.</p> <p><b>ii.</b> Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:</p> <p style="padding-left: 40px;"><b>a.</b> 3% for each 305 meter elevation above MSL</p> <p style="padding-left: 40px;"><b>b.</b> 1% for each 5.6° C rise in air temperature above 15.6° C</p> <p><b>iii.</b> The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.</p> <p>Bidder to confirm the same.</p> |  |
| 35. | Offered pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| 36. | Hydraulic test pressure of casing shall be 1.5 times the MAWP.Test duration shall be minimum 60 min. Pls confirm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |

**SIGNATURE:**

**NAME:**

**DESIGNATION:**

**COMPANY:**

**DATE:**

**ANNEXURE-4B to BHEL Tender Specification:**

**CHECKLIST FOR OFFER FOR HYDRANT BOOSTER PUMP WITH DRIVES (MOTOR/DIESEL ENGINE)**

| S.No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder's Reply |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.    | Bidder to confirm that the following documents are submitted along with their offer to enable BHEL to evaluate the offer.<br>a)Duly filled in Pump-Motor-Diesel Engine datasheet (Annexure-2)<br>b)Tentative GAD for Pump with Motor & Engine<br>c)Performance curves for pump<br>d)T-S curve for Hydrant Booster Pumps<br>e)Un-priced copy of price in attached BHEL price bid formats (Annexure-3) indicating quoted/ not quoted against each row & column.<br>f)Equipment qualification criteria / PTR / Reference Lists (Annexure-6)<br>g)Checklist as per (Annexure-4)<br>h) No Deviation Certificate as per (Annexure-10) |                |
| 2.    | All-important documents such as unpriced price bid, reference list, pump performance curve, Pump & drive assembly GA drawings, CS drawings must necessarily to be furnished by bidder along with their offer for evaluation.<br><b>Bidder to once again check their offer before submission and confirm.</b>                                                                                                                                                                                                                                                                                                                    |                |
| 3.    | Scope of supply as per Tender Specification. Bidder to Confirm.<br><b>Further any document indicating scope of supply submitted by bidders shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
| 4.    | Bidder to confirm that Performance requirement, Design and construction of the offered Pump model shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 5.    | Bidder to confirm that Performance requirement, Design and construction of the offered Diesel Engine shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| 6.    | Bidder to confirm that Performance requirement, Design and construction of the offered Motor shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |
| 7.    | Refer Annexure-2 of Tender Specification: Datasheet of Hydrant Booster Pump-Motor & Engine Datasheet. Duly filled Annexure-2 is enclosed with bidder's offer as indicated Tender Specification, Bidder to Confirm.<br><b>Datasheets in other formats shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                 |                |
| 8.    | Bidder to confirm that stand mounted DECP along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |
| 9.    | Bidder to confirm that suitable supporting structure for Fuel tank along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |
| 10.   | Bidder to confirm that suitable supporting structure for Battery along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 11.   | Suitable power, control and signal cable with glands & lugs for cable between Control panel, Battery, Battery charger and Diesel Engine shall be included in bidder scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                    |                |
| 12.   | Bidder to provide suitable Power cable gland and lugs for motor. Cable details shall be furnished during detail engineering stage. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
| 13.   | Bidder to provide suitable canopy for each motor. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| 14.   | 1 No. of suitable motor (ex-proof type) operated and 1No. of hand operated barrel pumps are considered by the bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 15. | Minimum instrumentations indicated in Tender Specification, bidder to include it in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 16. | 15 m of exhaust piping with silencer & insulation with 6 Nos. of bends are included in bidder's scope of supply. The exhaust piping shall consist of bends, hood, bird screen etc. Deviation in this is not acceptable. <b>Bidder to Confirm.</b>                                                                                                                                                                                                       |  |
| 17. | Battery [Lead Acid plante type] and battery charger is considered by bidder in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                           |  |
| 18. | Coupling between pump and drives, [Motor/Engine] shall be as per BHEL Tender Specification. Accordingly coupling mandatory spares to be considered as per BHEL Tender Specification. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                            |  |
| 19. | Suitable reducers/expanders & counter flanges along with gaskets & stud nuts at all the terminal points are considered by bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                               |  |
| 20. | <b>Auxiliaries Equipment/Spares:</b> All auxiliary equipment [clause no 7.4.5.7.3 of TAC] & spares [7.4.5.11 of TAC] as per TAC are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                       |  |
| 21. | Bidder to furnish list of commissioning spares as per OEM recommendation. Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                     |  |
| 22. | Bidder to furnish list of special tools & tackles. All the special tools and tackles indicated in tender specification are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                |  |
| 23. | Bidder to furnish list of 2 year recommended spares as per OEM recommendation. Bidder to quote for the same in the price bid as optional price. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 24. | Bidder to meet the Equipment Qualification Criteria. All the references shall be submitted along with the offer as per Annexure-6. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                              |  |
| 25. | Painting schedule shall be as per Annexure-4 of Tender Specification, Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                |  |
| 26. | <b>Inspection, Testing requirements for Pump &amp; Drive assembly:</b><br>Inspection, Testing requirements shall be as per BHEL QAP & specification requirement only. Bidder to note that QAP shall be as per Annexure-7 & the same shall be discussed during detail engg. However in case of practical difficulties in meeting the quality requirement, same shall be mutually discussed & agreed during detail engg. Stage. Bidder to note & confirm. |  |
| 27. | Make of all the items shall be as per Annexure-8 (Sub-Vendor List). Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                  |  |
| 28. | Bidder to confirm compliance with Annexure-9, Master Document List enclosed with Tender Specification, wrt list of documents, schedule of submission.                                                                                                                                                                                                                                                                                                   |  |
| 29. | Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight & Consider the same.                                                                                                                                                                                                                                    |  |
| 30. | Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer. Any deviation/ queries raised during technical bid submission shall not be entertained. Bidder to Confirm.                                                                                                                                                                                  |  |
| 31. | Bidder to quote as per Annexure-3, Price Bid Format only.<br>Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed with bidder's offer. Bidder to check and confirm.                                                                                                                                               |  |
| 32. | Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and confirm.                                                                                                                                                                                                                                                                                                                                           |  |
| 33. | Refer Annexure-2 of Tender Specification. The casing material mentioned in shall cater to the Hydraulic test pressure of                                                                                                                                                                                                                                                                                                                                |  |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|     | casing Kg/cm <sup>2</sup> (g) as mentioned in Annexure 2..If Not, bidder to consider superior material of casing. <b>Bidder to confirm.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 34. | Bidder to provide PLC control Panel for each diesel engine driven pump. Bidder to submit Soft copy and hard copy of logics executed in PLC for uploading the same by end customer later. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 35. | <p><b>Engine rating shall be as mentioned below:</b></p> <p><b>i.</b> The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.</p> <p><b>ii.</b> Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:</p> <p style="padding-left: 40px;"><b>a.</b> 3% for each 305 meter elevation above MSL</p> <p style="padding-left: 40px;"><b>b.</b> 1% for each 5.6° C rise in air temperature above 15.6° C</p> <p><b>iii.</b> The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.</p> <p>Bidder to confirm the same.</p> |  |
| 36. | Offered pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| 37. | Bidder confirm Motor starting current as per specification. Ie 600% subject to IS tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 38. | Hydraulic test pressure of casing shall be 1.5 times the MAWP.Test duration shall be minimum 60 min. Pls confirm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |

**SIGNATURE:**

**NAME:**

**DESIGNATION:**

**COMPANY:**

**DATE:**

**ANNEXURE-4C to BHEL Tender Specification:**

**CHECKLIST FOR OFFER FOR SPRAY BOOSTER PUMP WITH DRIVES (MOTOR/DIESEL ENGINE)**

| S.No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bidder's Reply |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.    | Bidder to confirm that the following documents are submitted along with their offer to enable BHEL to evaluate the offer.<br>a)Duly filled in Pump-Motor-Diesel Engine datasheet (Annexure-2)<br>b)Tentative GAD for Pump with Motor & Engine<br>c)Performance curves for pump<br>d)T-S curve for Spray Booster Pumps<br>e)Un-priced copy of price in attached BHEL price bid formats (Annexure-3) indicating quoted/ not quoted against each row & column.<br>f)Equipment qualification criteria / PTR / Reference Lists (Annexure-6)<br>g)Checklist as per (Annexure-4)<br>h) No Deviation Certificate as per (Annexure-10) |                |
| 2.    | All-important documents such as unpriced price bid, reference list, pump performance curve, Pump & drive assembly GA drawings, CS drawings must necessarily to be furnished by bidder along with their offer for evaluation.<br><b>Bidder to once again check their offer before submission and confirm.</b>                                                                                                                                                                                                                                                                                                                  |                |
| 3.    | Scope of supply as per Tender Specification. Bidder to Confirm.<br><b>Further any document indicating scope of supply submitted by bidders shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |
| 4.    | Bidder to confirm that Performance requirement, Design and construction of the offered Pump model shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |
| 5.    | Bidder to confirm that Performance requirement, Design and construction of the offered Diesel Engine shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
| 6.    | Bidder to confirm that Performance requirement, Design and construction of the offered Motor shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |
| 7.    | Refer Annexure-2 of Tender Specification: Datasheet of Spray Booster Pump-Motor & Engine Datasheet. Duly filled Annexure-2 is enclosed with bidder's offer as indicated Tender Specification, Bidder to Confirm.<br><b>Datasheets in other formats shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                 |                |
| 8.    | Bidder to confirm that stand mounted DECP along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |
| 9.    | Bidder to confirm that suitable supporting structure for Fuel tank along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
| 10.   | Bidder to confirm that suitable supporting structure for Battery along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |
| 11.   | Suitable power, control and signal cable with glands & lugs for cable between Control panel, Battery, Battery charger and Diesel Engine shall be included in bidder scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                  |                |
| 12.   | Bidder to provide suitable Power cable gland and lugs for motor. Cable details shall be furnished during detail engineering stage. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |
| 13.   | Bidder to provide suitable canopy for each motor. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |
| 14.   | 1 No. of suitable motor (ex-proof type) operated and 1No. of hand operated barrel pumps are considered by the bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |



|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 15. | Minimum instrumentations indicated in Tender Specification, bidder to include it in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 16. | 15 m of exhaust piping with silencer & insulation with 6 Nos. of bends are included in bidder's scope of supply. The exhaust piping shall consist of bends, hood, bird screen etc. Deviation in this is not acceptable. <b>Bidder to Confirm.</b>                                                                                                                                                                                                       |  |
| 17. | Battery [Lead Acid plante type] and battery charger is considered by bidder in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                           |  |
| 18. | Coupling between pump and drives, [Motor/Engine] shall be as per BHEL Tender Specification. Accordingly coupling mandatory spares to be considered as per BHEL Tender Specification. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                            |  |
| 19. | Suitable reducers/expanders & counter flanges along with gaskets & stud nuts at all the terminal points are considered by bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                               |  |
| 20. | <b>Auxiliaries Equipment/Spares:</b> All auxiliary equipment [clause no 7.4.5.7.3 of TAC] & spares [7.4.5.11 of TAC] as per TAC are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                       |  |
| 21. | Bidder to furnish list of commissioning spares as per OEM recommendation. Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                     |  |
| 22. | Bidder to furnish list of special tools & tackles. All the special tools and tackles indicated in tender specification are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                |  |
| 23. | Bidder to furnish list of 2 year recommended spares as per OEM recommendation. Bidder to quote for the same in the price bid as optional price. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 24. | Bidder to meet the Equipment Qualification Criteria. All the references shall be submitted along with the offer as per Annexure-6. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                              |  |
| 25. | Painting schedule shall be as per Annexure-4 of Tender Specification, Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                |  |
| 26. | <b>Inspection, Testing requirements for Pump &amp; Drive assembly:</b><br>Inspection, Testing requirements shall be as per BHEL QAP & specification requirement only. Bidder to note that QAP shall be as per Annexure-7 & the same shall be discussed during detail engg. However in case of practical difficulties in meeting the quality requirement, same shall be mutually discussed & agreed during detail engg. Stage. Bidder to note & confirm. |  |
| 27. | Make of all the items shall be as per Annexure-8 (Sub-Vendor List). Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                  |  |
| 28. | Bidder to confirm compliance with Annexure-9, Master Document List enclosed with Tender Specification, wrt list of documents, schedule of submission.                                                                                                                                                                                                                                                                                                   |  |
| 29. | Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight & Consider the same.                                                                                                                                                                                                                                    |  |
| 30. | Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer. Any deviation/ queries raised during technical bid submission shall not be entertained. Bidder to Confirm.                                                                                                                                                                                  |  |
| 31. | Bidder to quote as per Annexure-3, Price Bid Format only.<br>Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed with bidder's offer. Bidder to check and confirm.                                                                                                                                               |  |
| 32. | Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and confirm.                                                                                                                                                                                                                                                                                                                                           |  |
| 33. | Refer Annexure-2 of Tender Specification. The casing material mentioned in shall cater to the Hydraulic test pressure of                                                                                                                                                                                                                                                                                                                                |  |



|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|     | casing Kg/cm <sup>2</sup> (g) as mentioned in Annexure 2..If Not, bidder to consider superior material of casing. <b>Bidder to confirm.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 34. | Bidder to provide PLC control Panel for each diesel engine driven pump. Bidder to submit Soft copy and hard copy of logics executed in PLC for uploading the same by end customer later. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 35. | <p><b>Engine rating shall be as mentioned below:</b></p> <p><b>i.</b> The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump.</p> <p><b>ii.</b> Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following:</p> <p style="padding-left: 40px;"><b>a.</b> 3% for each 305 meter elevation above MSL</p> <p style="padding-left: 40px;"><b>b.</b> 1% for each 5.6° C rise in air temperature above 15.6° C</p> <p><b>iii.</b> The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.</p> <p>Bidder to confirm the same.</p> |  |
| 36. | Offered pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| 37. | Bidder confirm Motor starting current as per specification. Ie 600% subject to IS tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 38. | Hydraulic test pressure of casing shall be 1.5 times the MAWP.Test duration shall be minimum 60 min. Pls confirm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |

**SIGNATURE:**

**NAME:**

**DESIGNATION:**

**COMPANY:**

**DATE:**

**ANNEXURE-4D to BHEL Tender Specification:**

**CHECKLIST FOR OFFER FOR JOCKEY PUMP WITH DRIVES (MOTOR/DIESEL ENGINE)**

| S.No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bidder's Reply |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.    | Bidder to confirm that the following documents are submitted along with their offer to enable BHEL to evaluate the offer.<br>a)Duly filled in Pump-Motor datasheet (Annexure-2)<br>b)Tentative GAD for Pump with Motor<br>c)Performance curves for pump<br>d)T-S curve for Jockey Pumps<br>e)Un-priced copy of price in attached BHEL price bid formats (Annexure-3) indicating quoted/ not quoted against each row & column.<br>f)Equipment qualification criteria / PTR / Reference Lists (Annexure-6)<br>g)Checklist as per (Annexure-4)<br>h) No Deviation Certificate as per (Annexure-10) |                |
| 2.    | All-important documents such as unpriced price bid, reference list, pump performance curve, Pump & drive assembly GA drawings, CS drawings must necessarily to be furnished by bidder along with their offer for evaluation.<br><b>Bidder to once again check their offer before submission and confirm.</b>                                                                                                                                                                                                                                                                                    |                |
| 3.    | Scope of supply as per Tender Specification. Bidder to Confirm.<br><b>Further any document indicating scope of supply submitted by bidders shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
| 4.    | Bidder to confirm that Performance requirement, Design and construction of the offered Pump model shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 5.    | Bidder to confirm that Performance requirement, Design and construction of the offered Motor shall be guided by the TAC/LPA recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |
| 6.    | Refer Annexure-2 of Tender Specification: Datasheet of Jockey Pump-Motor Datasheet. Duly filled Annexure-2 is enclosed with bidder's offer as indicated Tender Specification, Bidder to Confirm.<br><b>Datasheets in other formats shall not be reviewed.</b>                                                                                                                                                                                                                                                                                                                                   |                |
| 7.    | Bidder to provide suitable Power cable gland and lugs for motor. Cable details shall be furnished during detail engineering stage. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
| 8.    | Bidder to provide suitable canopy for each motor. Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| 9.    | Minimum instrumentations indicated in Tender Specification, bidder to include it in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                                                              |                |
| 10.   | Coupling between pump and drives shall be as per BHEL Tender Specification. Accordingly coupling mandatory spares to be considered as per BHEL Tender Specification. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                    |                |
| 11.   | Suitable reducers/expanders & counter flanges along with gaskets & stud nuts at all the terminal points are considered by bidder. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                                                       |                |
| 12.   | <b>Auxiliaries Equipment/Spares:</b> All auxiliary equipment [clause no 7.4.5.7.3 of TAC] & spares [7.4.5.11 of TAC] as per TAC are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                               |                |
| 13.   | Bidder to furnish list of commissioning spares as per OEM recommendation. Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                                                             |                |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 14. | Bidder to furnish list of special tools & tackles. All the special tools and tackles indicated in tender specification are included in bidder's scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                |  |
| 15. | Bidder to furnish list of 2 year recommended spares as per OEM recommendation. Bidder to quote for the same in the price bid as optional price. Bidder to Confirm.                                                                                                                                                                                                                                                                                      |  |
| 16. | Bidder to meet the Equipment Qualification Criteria. All the references shall be submitted along with the offer as per Annexure-6. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                                                                              |  |
| 17. | Painting schedule shall be as per Annexure-4 of Tender Specification, Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                |  |
| 18. | <b>Inspection, Testing requirements for Pump &amp; Drive assembly:</b><br>Inspection, Testing requirements shall be as per BHEL QAP & specification requirement only. Bidder to note that QAP shall be as per Annexure-7 & the same shall be discussed during detail engg. However in case of practical difficulties in meeting the quality requirement, same shall be mutually discussed & agreed during detail engg. Stage. Bidder to note & confirm. |  |
| 19. | Make of all the items shall be as per Annexure-8 (Sub-Vendor List). Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                  |  |
| 20. | Bidder to confirm compliance with Annexure-9, Master Document List enclosed with Tender Specification, wrt list of documents, schedule of submission.                                                                                                                                                                                                                                                                                                   |  |
| 21. | Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight & Consider the same.                                                                                                                                                                                                                                    |  |
| 22. | Any specific deviations, which are impractical, shall be raised in form of pre-bid queries as per Annexure-11 before submission of Techno Commercial offer. Any deviation/ queries raised during technical bid submission shall not be entertained. Bidder to Confirm.                                                                                                                                                                                  |  |
| 23. | Bidder to quote as per Annexure-3, Price Bid Format only.<br>Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed with bidder's offer. Bidder to check and confirm.                                                                                                                                               |  |
| 24. | Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and confirm.                                                                                                                                                                                                                                                                                                                                           |  |
| 25. | Refer Annexure-2 of Tender Specification. The casing material mentioned in shall cater to the Hydraulic test pressure of casing Kg/cm <sup>2</sup> (g) as mentioned in Annexure 2..If Not, bidder to consider superior material of casing. <b>Bidder to confirm.</b>                                                                                                                                                                                    |  |
| 26. | Offered pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. Bidder to confirm.                                                                                                                                                                                                                                                                                                |  |
| 27. | Bidder confirm Motor starting current as per specification. ie 600% subject to IS tolerance                                                                                                                                                                                                                                                                                                                                                             |  |
| 28. | Hydraulic test pressure of casing shall be 1.5 times the MAWP.Test duration shall be minimum 60 min. Pls confirm                                                                                                                                                                                                                                                                                                                                        |  |

**SIGNATURE:**

**NAME:**

**DESIGNATION:**

**COMPANY:**

**DATE:**

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-5         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                           |  |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| <p><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1>Annexure-5</h1> <p>Annexure 5- A: Technical Specification For Fire Protection System<br/> Annexure 5- B: Technical Specification For A.C. &amp; D.C. Motors<br/> Annexure 5- C: General Electrical Specification<br/> Annexure 5- D: C&amp;I Specification<br/> Annexure 5- E: Misc Specification</p> |  |  |  |
|                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                           |  |  |  |

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

**VOLUME-III E**

**SECTION-II**

**TECHNICAL SPECIFICATION  
FOR  
FIRE PROTECTION SYSTEM**

## CONTENT

| CLAUSE NO. | DESCRIPTION                                            |
|------------|--------------------------------------------------------|
| 1.00.00    | GENERAL INFORMATION                                    |
| 2.00.00    | CODES & STANDARDS                                      |
| 3.00.00    | SYSTEM DESCRIPTION                                     |
| 4.00.00    | OPERATIONAL PHILOSOPHY                                 |
| 5.00.00    | SCOPE OF WORK                                          |
| 6.00.00    | DESIGN BASIS AND INPUT                                 |
| 7.00.00    | DESIGN AND CONSTRUCTION                                |
| 8.00.00    | INSPECTION AND TESTING                                 |
| 9.00.00    | DRAWINGS, DATA & MANUALS TO BE SUBMITTED BY THE BIDDER |

## ATTACHMENT

|               |                                                                                      |
|---------------|--------------------------------------------------------------------------------------|
| ANNEXURE-I    | FIRE WATER PUMPS                                                                     |
| ANNEXURE-II   | DIESEL ENGINE                                                                        |
| ANNEXURE-III  | AIR COMPRESSOR                                                                       |
| ANNEXURE-IV   | FIRE WATER STORAGE TANKS & HYDROPNEUMATIC TANK                                       |
| ANNEXURE-V    | PIPES, FITTINGS, VAVES AND SPECIALTIES                                               |
| ANNEXURE-VI   | HOSE HOUSE                                                                           |
| ANNEXURE-VII  | DELUGE VALVE SHED                                                                    |
| ANNEXURE-VIII | DETECTORS                                                                            |
| ANNEXURE-IX   | TECHNICAL SPECIFICATION FOR NITROGEN GAS INJECTION SYSTEM FOR OIL FILLED TRANSFORMER |
| ANNEXURE-X    | FIRE TENDER                                                                          |

---

### DEVELOPMENT CONSULTANTS

(e-PCT-TS-K-02-2014-15-Vol III E-Sec-2.doc)

**VOLUME: IIIE**

**SECTION-II**

**TECHNICAL SPECIFICATIONS  
FOR  
FIRE DETECTION, ALARM AND PROTECTION SYSTEM**

**1.00.00 GENERAL INFORMATION**

This section covers the requirements envisaged for Fire Detection and Protection System including Alarm and Communication which will be used to control any outbreak of fire in the proposed 1 x 800 MW Sri Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 for Telangana State Power Generation Corporation Limited (TSGENCO) at Kothagudem, Telangana to reduce consequential damages by containing and extinguishing the same. This section of the Specification shall have two parts – Fire Extinguishing System and Fire Detection & Alarm System. Bidder's scope of work covers supply, erection, commissioning and testing of the entire fire detection, alarm and protection system including supply of all fire extinguishing equipment and systems, fire detectors, manual call points, linear heat sensing cables, all local, remote Fire detection alarm cum MIMIC panels, repeater fire alarm panels, PCs and peripherals, hardware and licensed versions of software as detailed hereunder, meeting all code requirements to make the system complete.

**2.00.00 CODES AND STANDARDS**

The system shall be designed keeping in view the recommendations of Tariff Advisory Committee (TAC) of Insurance Companies of India/LPA India/NFPA USA. Any other International Standard having equivalent stringent codes may also be considered. However, the system shall be approved by statutory authorities.

**3.00.00 SYSTEM DESCRIPTION**

For protection against fire, all yard equipment will be protected by a combination of hydrant system, automatic sprinkler spray system (emulsifier system), fixed foam system for oil handling areas, automatic high velocity and medium velocity sprinkler spray system, auto-modular clean agent system for control rooms apart from portable and mobile fire extinguishers located at strategic areas of plant buildings and adequate Passive Fire Protection measures.

Fire extinguishing system is broadly divided into following sub-systems:

3.01.01

### Hydrant System

The Hydrant System of Fire Protection essentially consists of a large network of pipe, both underground and over ground which feeds water to a number of hydrants valves – indoor as well as outdoor and to a number of outdoor type fixed installations. Water in the pipe network is kept pressurized by hydro-pneumatic tank and jockey pump arrangement. These hydrant valves are located in the entire power station including all the auxiliaries and buildings in the plant area. Hosepipes of suitable lengths fitted with standard accessories like branch pipes, nozzles etc. are kept in “Hose Houses” (for outdoor hydrants) and in “Hose Boxes” (for indoor hydrants). When the fire hoses are coupled to the hydrant valves through the instantaneous coupling, jet of water is directed towards the fire. Hydrant system protects the following building/facilities.

- a) Raw Water Pump House
- b) Entire Power House including Boiler Area and Turbine House.
- c) Mill Building.
- d) Mill reject system compressor house.
- e) ESP Control Building.
- f) Generator & Unit transformer, Station Transformers in transformer Yard, switchyard area.
- g) CW Pump House including chlorination plant and dosing pump house.
- h) DG & Compressor building.
- i) HFO & LDO/ HSD unloading and transfer pump house, pressurizing pump house area, HFO, LDO/HSD Day tank area.
- j) DM plant
- k) Coal Handling Plant including conveyors, TPs, Coal stack yard etc.
- l) Ash water pump house.
- m) Ash Slurry Pump House
- n) Ash Handling Plant Electrical cum Control Room
- o) Ash Handling Plant Compressor Room
- p) Fly Ash Vacuum Pump House
- q) AHP Chemical House in AHP Clarifier Area
- r) Effluent treatment Plant.
- s) Stores.

---

DEVELOPMENT CONSULTANTS

V.III E/S-II : 2

(e-PCT-TS-K-02-2014-15e-PCT-TS-K-02-2014-15-Vol III E-Sec-2.doc)



- t) Clarified Water Pump House
- u) Filtered water Reservoir and Pump House
- v) Sludge Sump & Pump House
- w) Filter Backwash Waste Sump & Pump House
- x) Chemical House
- y) Chlorination Building

Note: Buildings not specifically identified above but required to be covered by hydrant system shall also be included in the scope of the Bidder.

### 3.01.02 High Velocity Water Spray System (HVWS System)

- a) Category- A

This system shall automatically detect, control and extinguish any outbreak of fire and simultaneously give audible alarm. The system shall also be designed for remote operation. Water line forms a ring around the equipment to be protected with projected outlets at various selected points fitted with the specially designed nozzles. The water supply to the HVW spray system is controlled by deluge valve, which shall be operated hydraulically. This valve is normally closed by water pressure in the water piping. The same water pipe forms a ring around the equipment to be protected and frangible bulb type detectors are mounted on this water line at selected places. When the surrounding temperature rises more than the rated temperature of the detector, detector quartzoid bulb collapses releasing water and consequently pressure in water line will fall sharply. This fall of pressure opens the deluge valve and water starts projecting out from the projectors. Local audible alarm shall be produced by water motor alarm gong. The operation of the Deluge Valve shall be annunciated in the Local Zonal Fire Alarm Panel as well as in the Central Fire detection alarm cum MIMIC panel.

The system shall also have a manual over riding facility along with regular testing facility

Category – A type HVW Spray Protection shall be provided for the following equipment:

- Three (3) nos. single phase generator transformer.
- Two (2) nos. Unit transformers.
- Unit and Station Auxiliary transformers as per design requirement.

- Spare Generator Transformer

b) Category- B

In this system fire shall be detected by use of heat detectors, flame detectors depending upon the area. Upon detection of fire, HVW Spray System shall be brought in operation automatically by opening deluge valves.

Category – B type HVW Spray System shall be provided for the following areas:

- Turbine oil tanks and purifiers.
- Boiler Firing Floors.
- Lube oil piping in turbine areas.
- Generator seal oil system.
- Lube oil system for turbine driven boiler feed pumps.
- All oil filled transformer below 10 MVA.

3.01.03 **Medium Velocity Water Spray System**

This system essentially consists of a network of sprayers fitted with a special deflector to give required angle of discharge for the water around the area to be protected. The sprayers discharge a cone of water spray consisting of medium size droplets of water. The droplet size shall be so designed to achieve efficient cooling of the flame zone by evaporation and sufficiently large to penetrate the flame so as to reach and cool surfaces heated by the fire. The operation of the deluge valves in MVW Spray System shall be annunciated in the respective local zonal panels and in the central Fire detection alarm cum MIMIC panel with repeat alarm at fire station buildings. For avoiding overall flooding of the area, in the event of fire, only the two adjacent zones on either side shall only operate.

The Medium Velocity Water Spray System shall be provided for the protection of following areas:

- All conveyor galleries, transfer points, and bunker bay conveyors in coal handling plant. In this connection, it may be noted that full length of each conveyor both top and bottom belt shall be protected with MVW Spray System.

Spray system for coal conveyor galleries shall be divided in several zones fed through individual deluge valves. Spray system for each zone shall consist of spray nozzles mounted, on a water network. Spray system shall cover both forward and return belts of conveyor including hoppers, feeders & head end pulley. Detection system shall consist of quartz bulb detectors, IR detectors, LHS cables.

- Cable vault and cable galleries of main plant, switchyard control room, and ESP control room. Detection system shall consist of smoke detectors, LHS cables.
- Fuel oil storage and day tank area, DG set diesel tanks.

#### 3.01.04 Fixed Foam Protection System

Water based automatic activated low expansion foam protection system shall be provided for HFO & LDO/ HSD storage and day tanks.

Foam protection systems are based on the principle of blanketing the burning surface of oil stored inside the tanks by pouring foam mixed with water, enabling to cut-off the oxygen to the burning fuel thus achieving immediate Extinguishments of fire.

Foam concentrate will be pumped from the foam concentrate storage tank by two (1W + 1S) foam pumps to foam proportioner skids one provided for each fuel oil (FO) tank. Pressurized water connection is provided to the eductor of each foam proportioner skid. In the event of fire, the foam system for respective tank shall be automatically activated on detection of fire by ROR/Probe type heat detectors provided inside the FO tanks. Water will start flowing through the eductor where foam concentrate is induced and mixed with the flowing water in definite proportion.

This foam water mixture flows to tank, where the foam solution expands by sucking air from the atmosphere and foam thus formed fills the oil surface inside tank by suitably designed deflectors.

#### 3.01.05 Inert gas flooding system / Auto modular clean agent system

One centralized total flooding type clean inert gas extinguishing system shall be provided for the following areas as a protection for fire damage.

- Control room, Control equipment room, computer room and other electrical and electronic equipment rooms.

The inert gas flooding system for the above areas shall consist of battery of inert gas storage cylinders of adequate capacity, which shall be located suitably at a centralized location. Discharge nozzles shall be provided on the gas distribution pipe network suitably located on the areas to be protected.

In the event of fire, the fire detectors initiate an alarm in the local panel, and main fire alarm panel. Simultaneously, the detection signal opens the valves automatically and the protected area is filled up by rapid injection of required quantity of inert gas through the pipe network and discharge nozzles to create a homogenous air/inert gas atmosphere within.

The pipe network shall be connected to a gas manifold, through a manually operated valve. The manifold shall be connected to a group of inert gas cylinders

- 3.01.06 Portable and mobile (wheel mounted) fire extinguishers, such as soda acid type, pressurized water type, carbon-dioxide type, foam type , dry chemical powder type shall be located at strategic locations throughout the plant area.
- 3.02.00 Microprocessor based addressable analog type multi criteria smoke detectors connected in cross-zoning principle as per NFPA recommendation and in two wires circuitry shall be provided in the following areas:
- All cable Spreader Rooms & Cable Vaults, cable gallery in powerhouse and in all ancillary plant buildings.
  - All Electrical Switchgear/MCC Rooms located in Power House and in all ancillary plant buildings.
  - Central Control Rooms, Control equipment room housing DDCMIS, UPS etc. and in all ancillary plant building control rooms.
- 3.03.00 Heat detection system (microprocessor based analogue addressable based heat detector) shall be provided in the following areas in order to avoid spurious operation of the smoke detectors due to fumes, smoke & dust which are present in these areas:
- Battery and battery charger rooms.
  - Turbine oil tanks and purifiers.
  - Boiler Firing Floors.
  - Lube oil piping in turbine areas.
  - Generator seal oil system.
  - Lube oil system for turbine driven boiler feed pumps.
  - All oil filled transformer below 10 MVA.
- 3.04.00 Quartzoid bulb detector shall be used in all transformers rated more than 10 MVA.
- 3.05.00 Heat sensing cable, as detector shall be used for coal conveyor gallery including bearings and both drive pulley and non-drive pulley, transfer points. This shall be used in whole length of top belt and bottom belt (in a zig-zag fashion). These detectors shall also be used for tripping the conveyor drives.
- 3.06.00 Solar Blind Infra-red detectors with inbuilt air purging unit shall be used in coal conveyor gallery for detection of moving fire. Rate of rise cum fixed

temperature heat detectors shall be used for Boiler burner fronts, turbine oil tanks and HFO and LDO/HSD storage day tank inside. Heat detectors shall be analogue addressable type.

3.07.00 The entire Power House Building and the outdoor yard of plant have been divided into a number of zones with a few addressable manual call points in each zone. The outdoor call points shall be installed on approximately 1M high angle iron supports for ease of operation. The manual call points inside the Power House Building shall be suitable for wall mounting. Manual call points of "break glass push button station type" or "lever type" shall be provided specifically in the following areas:

- a) Switch gear and MCC room in Power house.
- b) Outdoor transformer yard.
- c) All floors in power House, including Boiler House.
- d) All areas of boiler house.
- e) Coal bunker and coal mill area.
- f) Transfer points.
- g) All pump houses namely CW Pump House, Ash Water Pump House, Fire Water Pump House etc.
- i) All buildings like Compressor and DG area etc.

Adequate number of manual call points along with automatic fire alarm system shall be provided for the respective areas. Location of the manual call points shall be near to the respective areas. Annunciations from the manual call points shall be received to the nearest satellite fire alarm panel and directly on the fire alarm panels located in the Control room and fire station.

3.08.00 All detectors shall be located and spaced as per NFPA-72E and shall be UL/FM approved. On receipt of impulse from the detectors, in the event of fire, suitable annunciation signals shall be exhibited in the respective repeater fire panels as well as Main and Master Fire Panels. The areas including electrical control rooms, switchgear rooms, cable vault, coal conveyors etc shall be suitably sectionalized as far as the fire detection is concerned and as such the affected Zone can also be spotted.

3.09.00 Passive Fire Protection System for all outdoor transformers and indoor transformers having rating more than 10 MVA, Cable Vault, Cable Spreader Room & Enclosed Cable Risers (Cable Shafts) shall be provided.

3.09.01 The Transformer to be protected by automatic High Velocity Water Spray System shall be separated from each other by explosion proof barrier walls of 120 minutes fire rating so that fire in one does not affect the adjacent Transformers.

3.09.02 The Cable Spreader Room and Cable Vault shall be divided into a smaller

- risk zones. These zones shall be separated by 120 minutes rating fire barrier walls.
- 3.10.00 For containment of fire and preventing it from spreading in cable galleries, unit wise fire barriers with self-closing fire doors will be provided. In addition, all cable entries / openings in the cable galleries, tunnels, floors will be sealed with non-inflammable / fire resistant sealing materials to prevent fire propagation for at least three (3) hour. Fire protection cable coating compound over cables at switchgear entry points, power station building entry points and trays shall be provided to prevent damage from fire for at least thirty (30) minutes. The number of fire doors as prescribed by the TAC/LPA shall be provided. Atleast two fire escape exit openings to the open areas shall be provided for the TG area as prescribed by the TAC/LPA.
- 3.11.00 Back Lit maintained type emergency "exit light" shall be provided in control room, control equipment rooms, switchgear and MCC rooms, battery charger rooms, escape stair case in power house and transfer points in coal conveyor area and other buildings in the plant. These shall be switched on upon detection of fire.
- 3.12.00 Addressable analog smoke detector shall also be provided in all false ceiling in power house i.e. Control room, Control equipment room, ESP control room.
- 3.13.00 "First aid fire protection system" shall be provided for Power house.
- 3.14.00 Gas sensing fire detectors working on air sampling shall be provided for all control rooms, and control equipment room.
- 3.15.00 Provision should be kept for automatic closing of fire dampers in ventilation ducts or tripping of related ventilation fans as required on detection of fire.
- 3.16.00 The main source of water to the fire pumps and jockey pumps shall be from steel made fire water storage tank which is to be sized by the EPC contractor based on TAC/LPA guideline. However, the minimum capacity of the steel tank shall be 5000 m<sup>3</sup> with two compartments . The Water for both hydrant and High/Medium Velocity Water Spray System shall be supplied by six (6) nos. automatic firewater pumps. Out of six (6) pumps two (2) nos. motor driven working hydrant pumps and one (1) no. diesel engine driven standby hydrant pumps for hydrant system and one (1) no. motor driven and one (1) no. diesel engine driven (both are working) spray pumps for HVW & MVW spray water system and one (1) no. diesel engine driven pump is common standby for spray system. Out of these six (6) nos. fire water pumps three nos. (3) will be motor driven and three (3) nos. will be diesel engine driven. The pumps will be started automatically in proper sequence when a large quantity of water flows out from pressurized water circuit. There shall be adequate arrangement of meeting up system leakages and at the same time the system pressure shall be maintained by providing a hydro pneumatic tank along with two (2) nos. motor driven jockey pumps, one (1) working and one (1) standby and two (2) nos., one (1) working & one (1) standby compressors. Booster Pumps shall be provided as per the TAC/LPA guidelines. However, the no. of pumps and their capacity, head etc. are to be finally decided by the Contractor during detail engineering stage.

- 3.17.00 If water pressure in the hydrant pipe network is not adequate to maintain minimum 3.5 kg/cm<sup>2</sup> (g) at the hydraulically furthest hose station at elevated floors of boiler houses and turbine building, then 2x100% motor driven booster pumps shall be provided for individual areas for supplying pressurized water to the hose stations. Booster pumps are installed online to the branch header to riser pipes. The booster pumps if required shall start through pressure switch when pressure on their discharge side falls below the set pressure.
- 3.18.00 Adequate separating distances will be maintained between different process blocks and hazardous equipment. To prevent fire from spreading through ventilation & air conditioning ducts, dampers with auto closing arrangements will be provided at appropriate locations. FRLS power and control cables will be used.
- 3.19.00 **Nitrogen Injection System**
- Nitrogen Injection Fire Prevention and extinguishing system designed for oil filled transformer (for Generator Transformer) shall prevent tank explosion and the fire during internal faults resulting in the arc where tank explosion will normally take few seconds after arc generation and also to extinguish the external oil fires on transformer top cover due to tank explosion and/ or external failures like bushing fires, due to OLTC fires and fire from surrounding equipments.
- Nitrogen Injection System shall be provided along with the emulsifiers for the transformers.
- The system shall work on the principle of DRAIN and STIR and on activation, shall drain a pre determined quantity of oil from the tank top through outlet valve, to reduce the tank pressure and inject nitrogen gas at high pressure from the lower side of the tank through the inlet valves to create stirring action and reduce the temperature of top oil surface below flash point to extinguish the fire.
- Conservator tank oil shall be isolated during the bushing bursting, tank explosion and oil fire, to prevent aggravation of oil fire.
- Transformer isolation shall be an essential pre condition for activation of the system.
- The system shall be designed to operate manually, in case of failure of power source.
- The details including Design, description, control, scope, etc. of this system are attached with Annexure-IX of this specification.
- 3.20.00 Two (2) nos. Mobile Fire tenders shall be envisaged for this project. However as no fire station is envisaged, these two (2) nos. mobile fire tenders shall be placed in the new fire Station of the unit of this project. For details of Fire Tender, refer to Annexure-X of this Volume.



4.00.00 **OPERATIONAL PHILOSOPHY**

4.01.00 **Hydrant System**

4.01.01 Operation of hydrant system shall be semi-automatic. A pressurized hydrant main shall be maintained through the combination of hydro pneumatic tank, jockey pumps and compressors. When the header pressure of fire water pumps falls below a preset limit, diesel engine driven fire water pump placed in "auto mode" shall be automatically cut-in. If the header pressure is not built-up even after the running of diesel engine driven pump and falls further down, this low pressure shall actuate another pressure switch which in turn shall cut in automatically the standby Diesel Engine driven hydrant pump. In each case above, if any of the above pumps is not started even after the signal from pressure switch is through, "pump fails to start" alarm shall be annunciated in the local control panel.

4.01.02 Hydro-pneumatic tank shall be filled up with water up to 2/3rd portion of its height. Air space shall be kept above the water- filled portion. The hydro-pneumatic tank will be equipped with necessary level switches and pressure switches. Minor leakage in the pressurized fire water system shall be replenished from hydro-pneumatic tank. When the level of hydro pneumatic tank is low, jockey pump shall be started automatically to replenish the level of water in the tank. Jockey pump shall be cut-out automatically when the level of water in the hydro pneumatic tank reaches its higher limit. Pressure switches provided in the hydro pneumatic tank shall be interlocked with the cut-in/cut-out operation of compressor which is used to maintain a constant pressure in the hydro pneumatic tank and there by to the whole fire fighting system.

4.02.00 **Spray Water System**

4.02.01 Operation of Spray Water System shall be automatic.

4.02.02 Header pressure of spray water system shall be maintained at a constant value with the help of hydro pneumatic tank as stated earlier in case of hydrant system.

4.02.03 When the pressure of spray water system falls down to a preset value, it will actuate a pressure switch which in turn shall send starting signal to the motor/ diesel engine driven HVW/ MVW spray water pump for automatic starting. If the pressure falls further below, common standby Diesel Engine driven pump shall be started automatically from the signal of it's pressure switch. Further, if necessary to arrest the falling pressure pumps for hydrant system shall also be started automatically and deliver water to the spray water system.

In each case above, "pumps fail to start" alarm shall be annunciated in LCP if any pump does not start even the start-up of signal from it's pressure switch is through.

4.02.04 Any Fire water pump, if started automatically, shall not be stopped without manual intervention.



- detector and alarm system, local alarm panel and other required accessories for the protected areas as specified elsewhere in the specification.
- m) Required nos. of portable fire extinguisher.
  - n) Outdoor hydrant valves with hoses, solid jet/triple purpose/fog type branch pipes with nozzles and quick coupling as required for the entire outdoor hydrant system specified. The equipment shall be as per specification.
  - o) Indoor hydrants (landing valves) with hoses, triple purpose branch pipe with nozzles and quick coupling end & "hose boxes" as required for the entire indoor hydrant system specified as per TAC/LPA rules.
  - p) Out of total nozzles provided in indoor & outdoor hydrant system, at least 10% shall be "fog type" and balance shall be of ordinary type.
  - q) The number of hose houses and hoses shall be as per TAC/LPA stipulations.
  - r) 32 mm NB connections for first aid hose reels, first aid hose reels along with branch pipe fitted with nozzles and quick coupling ends and isolating valves, hose boxes as required for the entire first aid fire protection system specified.
  - s) Sets of hydraulically operated deluge valves with bypass valve, isolating valve & test valve for all HT transformers as specified.
  - t) Sets of solenoid operated deluge valves with bypass valve, isolating valve & test valve for entire spray system for coal conveyors, turbine lub oil tank, boiler burner front and cable vault/spreader rooms.
  - u) Two (2) nos. of basket type strainers to be located at the discharge of spray water pumps.
  - v) Sets of Chrome plated frangible bulb type detectors for areas identified elsewhere in the specification.
  - w) Sets of addressable analog optical type of smoke detection arranged in X-zoning fashion for areas identified in the specification.
  - x) Sets of addressable analog multi criteria smoke detectors arranged in X-zoning fashion for areas identified in the specification.
  - y) Sets of Analogue Addressable type heat detectors for the areas identified in specification.
  - z) Solar blind Infrared detectors with inbuilt air purging unit for each conveyor. Dual wavelength Infrared flame detectors for boiler burner fronts and turbine oil tanks.

- hook-up with each Satellite Fire Alarm Panel to indicate group zone-wise fire annunciation from Satellite Fire Alarm Panels. Fire detection alarm cum MIMIC panels shall also supervise, monitor and annunciate the abnormal condition of the circuitry of the fire detection system through local panels.
- 6.03.05 External circuit supervision shall not require additional wires other than the pair used for detection or alarm. These two wires shall provide both supervision and alarm signals.
- 6.03.06 Upon activation of any detection device installed in the circuit, the system shall automatically report the status and initiate the sequence of operations with the following functions as minimum :
- a) Sound an alarm on audible devices.
  - b) Notify automatically central fire station.
  - c) Light an indicating lamp on device initiating the alarm.
  - d) Display "zone" and / or device no. on the panel with defined message.
  - e) Activate the output relays for shutdown of ventilation/air- conditioning system, coal conveyor etc. as per requirement.
  - f) Actuate in fire protection devices & deluge valves etc.
- 6.03.07 Alarm shall have priority over trouble. All trouble conditions shall be reported to include the zone / device no., location etc.
- 6.03.08 In the event of detection of fire, auxiliary systems like ventilation, air-conditioning may require shutdown. For this purpose potential free contacts from the output of the fire protection system shall be made available in the local / main fire panel and terminated in the terminal block
- 6.03.09 The Fire detection alarm cum MIMIC panels as well as Master Fire Alarm Panel shall have provision and facilities for connection to Intel i5 (or latest version at the time of supply) WIN NT (or latest at the time of supply) based Personal Computer with SVGA Monitor and dot matrix printer to be provided by the Bidder. Fire response program shall be furnished on screen and automatic action shall be initiated by keyboard / mouse operation.
- 6.04.00 **Civil**
- 6.04.01 Buried piping shall be laid generally at a depth of 1.0 M below grade. In case of road crossing, same shall be 1.5 M minimum.
- 6.04.02 Construction of Valve chamber for under ground pipes, Hose house and shed for deluge valves and compressor as per good engineering practice.
- 7.00.00 **DESIGN AND CONSTRUCTION**
- 7.01.00 **Fire Water and Jockey Pumps**

7.01.01 **Performance Requirement**

- a) Performance requirement for the pumps shall be guided by the 'Data Sheet' enclosed in this section and TAC/LPA recommendation.
- b) Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. The shut-off head shall not exceed 120 % of rated head in the case of horizontal pumps and 140 % in the case of vertical turbine type pumps.
- c) Pump-Motor sets shall be capable of continuously delivering the rated output for the voltage variation of ( $\pm$ ) 10% and frequency variation of ( $\pm$ ) 5% occurring separately or combined voltage and frequency variation of ( $\pm$ ) 10% (absolute sum).

7.01.02 **Constructional Features**

- a) The design and Testing Standards of the Pumps shall conform to the standards as indicated in the TAC/LPA recommendation.
- b) The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.
- c) Drive Unit Power rating for the fire water pumps shall be selected such that it is equal to higher of the two conditions:
  - i) 110% of the duty point power requirement.
  - ii) Motor input power required at 150% of the duty point capacity of pump

7.02.00 **Diesel Engine**

7.02.01 Performance requirement of the diesel engine shall be guided by TAC/LPA recommendations.

7.02.02 The engine shall be capable of operating continuously on full load at the site conditions for a period of at least six (6) hours.

7.02.03 The engine shall be naturally aspirated, super charged or turbo-charged as recommended by the manufacturer. (Ref. Fire Protection Manual by TAC/LPA).

7.02.04 The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at its duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump. Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following for

normally aspirated engines only:

- a) 3% for each 305 metre elevation above MSL (Ref. NFPA, Volume-2, 1978).
- b) 1% for each 5.6° C rise in air temperature above 15.6° C (Ref. NFPA, Volume-2, 1978).

The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.

7.02.05 Design and construction of the diesel engine shall be guided by the TAC/LPA recommendations.

7.02.06 **Starting**

- a) The engine shall be capable of both automatic and manual start.
- b) Automatic cranking shall be effected by a battery driven D.C. motor having high starting torque to overcome full engine compression. Starting power shall be supplied from two (2) sets of storage batteries. One (1) set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch shall be provided at the automatic starting control panel to select any of the two (2) sets of battery for manual/auto starting of the engine.

The automatic starting arrangement shall include, as a safeguard, a "Repeat Start" feature so that if the pinion of the starting motor does not engage the flywheel at the first attempt, it is automatically retracted and after a short pause again will advance towards the flywheel.

This repeat start cycle will continue until five (5) kicks after which there will be suitable annunciation. The battery capacity shall be adequate for ten (10) consecutive starts without recharging with a cold engine under full compression.

- c) Arrangement for both trickle and booster charge of the batteries shall be provided. When the engine starts running, provision should be kept to ensure that the charger is automatically disconnected and the battery is charged by engine dynamo.

Each diesel engine shall be provided with two (2) battery charger units of air cooled design. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilised for charging any one of the two (2) batteries of that engine.

7.02.07 **Governing System**

- a) The engine shall be fitted with a speed control device that will control the speed under all conditions of load.
- b) The governor shall offer following features:
  - i) Engine should be provided with an adjustable governor capable of regulating engine speed within 10% of it's rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load. (Refer Fire Protection Manual by TAC/LPA).
  - ii) Engine shall be provided with an over speed shut-down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position. (Refer NFPA).
- c) The governor shall be suitable for operation without external power supply.

**7.02.08 Fuel System**

- a) The diesel engine will run on High Speed diesel oil, analysis of which has been indicated elsewhere in specification.
- b) Each engine shall be provided with fuel oil tank having storage capacity sufficient to run the engine at full load for at least six (6) hours.
- c) For each compression ignition engine driven pump set, there shall be individual fuel tank and fuel feed pipes.
- d) A suitable 1 phase 240 Volt fuel pump (portable) to be provided to fill up diesel oil from Diesel Drum received from supplier of Diesel. This pump should also have facility to be operated by hand, in case electricity fails.

**7.02.09 Lubricating Oil System**

Automatic pressure lubrication shall be provided by a crankshaft driven oil pump, taking suction from a sump and deliver pressurized oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath. The above lubricating oil sump shall be equipped with adequate heaters having thermostat control to maintain the lubricating oil at recommended temperature for maintaining oil at low viscosity.

**7.02.10 Cooling Water System**

The cooling water system shall conform to any one of the systems specified in Fire Protection Manual of the Regional committee of the Tariff Advisory Committee / LPA / NFPA. The Contractor shall clearly indicate in his offer the type of cooling system adopted. In case fire water is used as a cooling media by tapping of the water from the fire water pump discharge (before the pump discharge valve), the capacity of the fire pump shall be increased, so that the net capacity meets the specification requirement.

#### 7.02.11 Instrumentation & Control

The diesel engine shall be provided with adequate instrumentation. These shall include but not limited to the following:

- a) Temperature indicator (contact type) in cooling water inlet and outlet.
- b) Temperature indicator in lubricating oil outlet from the oil cooler.
- c) Pressure gauges (contact type) for lubricating oil system.
- d) Differential pressure gauges (contact type) across strainers/ filters.
- e) Speed indicator.
- f) Running hour meter.
- g) Dip stick type lubricating oil sump level indicator.
- h) Gauge glass type Fuel Oil Tank level indicator.
- i) Voltmeter & Ammeter in dynamo type battery charging circuit.

#### 7.03.00 Air Compressors

7.03.01 Air Compressors shall be designed for intermittent operation with high efficiency to satisfy the requirement as specified in the data sheets.

7.03.02 Compressor shall be mounted on an air receiver of suitable size so that delivery air pressure is kept within (+) 5% of rated pressure without excessive start-stop operations in the working cycle.

#### 7.03.04 Instrumentation and Miscellaneous Accessories

The package air compressor and drive shall be supplied complete with the following instrumentation and accessories as minimum.

- a) Discharge air pressure gauge.
- b) Pressure switch to control actuation of compressor drive motor.
- c) Starter for drive motor.
- d) Pressure relief valve.

7.07.04 Clear inscription reading (in English) "FIRE ALARM - IN CASE OF FIRE BREAK GLASS" shall be provided for each manual call point unit, either on the MS enclosure or on a separate metal plate mounted behind the glass cover. The metal plate for inscription shall not tarnish under the atmospheric conditions.

7.07.05 Each manual call point unit shall be provided with the following accessories:

- i) An iron hammer of sufficient weight, which could be used to break the glass cover. The iron hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible iron chain of sufficient length and play to facilitate easy breaking of the glass cover.
- ii) Two numbers diametrically opposite earthing studs located on the outside surface of the external MS enclosure.
- iii) An identification number (on a number plate) which will be invariably same as the number given to the fire alarm, indicating point on the Zonal and Main Fire Alarm panel. The identification number shall match with the address of the intelligent addressable Manual call point for easy identifying the Call Point unit.
- iv) A dust sealing gland or equivalent on the external MS enclosure for outgoing cable from the unit.
- v) A compression type cable terminating brass gland of reputed make for outgoing cable from the internal MS enclosure.
- vi) In addition to this a red lamp Response Indicator shall be provided which will light up on actuation of manual call point to locate the manual call point station, which is operated.

#### 7.08.00 **Control and Instrumentation**

For features and requirements of the control and instrumentation items including field instrument, Panels and Panel mounted instruments, relays, annunciators, selector switches, PLCs and other hardware and peripherals under scope of supply for the Fire Detection and Protection system. Bidder shall also refer the relevant clauses of the Volume VI of this Specification.

Specifications and data sheets for Detectors are furnished at the end of present Specification volume.

#### 7.09.00 **Battery and Battery Charger**

##### 7.09.01 **Battery**

- a) Battery to be located in Plant Service Water Pump House shall be suitable to meet starting requirements of Diesel Engine driven pumps. Besides these all controls, indications, annunciators etc. (including multiplication of process interlock relays and auxiliary relays) shall have power supply from 24 V (2 X 12 V) Battery and Battery Charger



unit.

- b) All controls, interlocks, indications, annunciation system etc. for each of the Fire detection alarm cum MIMIC panels (located in Central Control room) and the Repeater Panel (located in Fire Station), shall have power supply from 24 V (2 X 12V) Battery and Battery Charging Units. The Battery of each of the above Panels shall be located in the bottom portion of the same Panel. The PC with Printer in the central control room shall be powered up by the respective UPS Power of the Plant Instrumentation and Control System.
- c) Diesel Engine Driven Fire Water Pump  
  
The Battery shall have the capacity to start the Diesel engine at least for eleven starts. Further Battery shall have capacity to meet auxiliaries & other loads of Local Control Panel (if any) for a minimum period of 10 hours. Minimum Ampere-hour capacity of the Battery shall be selected accordingly.
- d) The Battery driven Power supply shall be available to main and repeater fire alarm panel shall be designed to provide supply for a minimum period of 10 hours. Minimum ampere hour capacity of the Battery shall be selected accordingly.
- e) Bidder shall compute the ampere hour capacity at suitable discharge rate based on above duty and furnish the calculation along with the Bid which shall consider the duty cycle and 25% & 15% compensation for ageing & unforeseen future growth respectively of each battery unit. The maximum and minimum ambient shall be 42°C and 11.7°C respectively.

The minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell.

#### 7.09.02 **Battery Charger**

For design and construction of Battery Charger refer Volume V.

#### 7.09.03 **Layout of Battery & Battery Charger**

- a) The battery and charger of the respective panels shall be an integral part of each of the main fire panel / local fire panel / repeater panel.
- b) Bidder shall indicate his own layout of 24 volt Battery and Charger to suit the space available.

#### 7.09.04 **Fittings & Accessories**

Battery

Each battery shall be furnished with necessary accessories required.



|         |                                                                                                                                                                                                                                                 |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8.00.00 | <b>INSPECTION AND TESTING</b>                                                                                                                                                                                                                   |
| 8.01.00 | <b>Pipes/Fittings</b>                                                                                                                                                                                                                           |
| 8.01.01 | Hydraulic test or Eddy Current test shall be carried out at manufacturer works on pipes as per IS: 1239 Part 1/ IS: 3589. Fittings (bends, elbow, etc.) shall be as per IS 1239 Part 2 or equivalent specification.                             |
| 8.01.02 | Butt welds joints on buried as well as on above ground pipes shall be subjected to radiographic inspection as per TAC/LPA's manual.                                                                                                             |
| 8.02.00 | <b>Water and Air Line Valves</b>                                                                                                                                                                                                                |
| 8.02.01 | All valves shall be tested as per relevant design code of valve.                                                                                                                                                                                |
| 8.02.02 | Valve trim material shall be subjected to NDT if diameter is equal to or greater than 50 mm.                                                                                                                                                    |
| 8.02.03 | Air tests shall be conducted as per applicable codes to detect seat leakages.                                                                                                                                                                   |
| 8.02.04 | As cast heat marks shall be provided on castings and must be co-related with test certificates.                                                                                                                                                 |
| 8.03.00 | <b>Hydrant Valves and Stand Post Assembly</b>                                                                                                                                                                                                   |
| 8.03.01 | The stand post assembly along with the hydrant valve (valve being open and outlet closed) shall be pressure tested to detect any leakage.                                                                                                       |
| 8.03.02 | Flow test shall be conducted on the hydrant valves. The flow through the valve shall not be less than 900 liters/min. Vendor may submit type test report of similar size of valves duly certified by reputed TPIA (eg Lloyds, BV etc) or by ISI |
| 8.03.03 | Leak tightness test of the valve seat shall be conducted.                                                                                                                                                                                       |
| 8.04.00 | <b>Indoor Hydrant Valves (Internal landing valves)</b>                                                                                                                                                                                          |
|         | Each internal landing valve shall be tested for pressure, flow and leak tightness as in clause no. 8.03.00 above.                                                                                                                               |
| 8.05.00 | <b>Hydrant Valves for First Aid Fire Protection System</b>                                                                                                                                                                                      |
|         | Each hydrant valve for first aid fire protection system shall be tested for pressure, flow and leak tightness as in clause no. 8.03.00 above.                                                                                                   |
| 8.06.00 | <b>Fire Water Monitors</b>                                                                                                                                                                                                                      |
|         | Tests shall be done on Fire Water Monitor as per Code and Data Sheet.                                                                                                                                                                           |
| 8.07.00 | <b>Hoses, Nozzles, Branch Pipes and Hose Boxes</b>                                                                                                                                                                                              |
| 8.07.01 | Rubber lined impregnated woven jacketed hoses shall be tested as per IS-636, Type-II and first aid fire protection hose shall be tested as per IS-444.                                                                                          |

In both cases, following tests shall be included.

- a) Percolation test      b) Pressure test      c) Burst test

The branch pipe, coupling and nozzles shall be subject to a hydrostatic test pressure to detect any leakage.

**8.08.00 Strainers**

Pressure drop test shall be carried out for basket strainers as well as Y-type line strainers.

**8.09.00 Battery and Battery Charger**

All equipment and components thereof shall be subject to shop tests as per relevant IS/IEC standards. The tests shall also include dielectric tests on Battery Charger.

**8.10.00 Fire detection alarm cum MIMIC panels and Repeater panels**

8.10.01 All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

**8.10.02 Routine Tests**

The tests for the panels shall include but not necessarily limited to the following :

- a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control schemes/annunciation system and proper functioning of the equipment/devices and continuity test of printed circuit cards.
- b) All wiring and current carrying part shall be given appropriate High Voltage Test.
- c) Routine test shall be carried out on all equipment such as contactors, relays, switch, fuse, instrument transformers, meters etc.
- d) Power frequency withstand test shall be performed on control/secondary wiring.

**8.10.03 Type Test**

Type test on typical section of a panel consisting of Transformer Panel, Power pack module unit, Control and operation unit, Annunciation unit etc. shall be performed as per relevant IEC/Fire codes.

**8.10.04 Auxiliary Equipment**

All component parts and auxiliary equipment such as space heater, insulator etc. shall be routine tested as per relevant IS/IEC.

8.11.00 **Type Tests on Fire Proof Sealing System and Fire Stop System**

The type tests for fireproof sealing system for floor/wall opening/fire stop system for bottom of Electrical Switchgear MCCs/Panel are as under:

- a) Fire rating test
- b) Hose stream test
- c) Accelerated ageing test
- d) Fire rating test on the penetration seal system built of accelerated aged components followed by Hose Stream Test.
- e) Temperature rise test for cable in the fire stop.
- f) Water absorption test followed by fire rating test.
- g) Flame resistance test for fire protection coating material.
- h) Anti-rodent Test.

The detailed test procedures for each of these tests are to be submitted by the bidder and is subject to approval by Owner/Consultant.

9.00.00 **DRAWING, DATA AND MANUALS TO BE SUBMITTED BY BIDDER**

9.01.00 **Drawings to be Submitted by the Bidder**

9.01.01 Flow diagram showing the complete fire protection scheme with associated controls for the following :

- i) Hydrant System both Indoor and Outdoor.
- ii) Automatic type High Velocity Water Spray System with quartzoid bulb detection system in pressurized water loop.
- iii) Automatic type Medium Velocity water spray system with digital type heat sensing cable as detector.
- iv) Multicriteria smoke detection system arranged in cross-zoning principle.
- v) Heat Detection System (IC type).
- vi) Diagram showing the lubricant system etc.

9.01.02 Schematic and wiring diagram for Battery Charger.

9.01.03 Layout arrangement of battery with catalogues.

9.01.04 Mounting arrangement of battery charger.

ANNEXURE-I

DATA SHEET  
FOR  
FIRE WATER PUMPS

|         |                              |   | Elec. Motor Driven                          | Diesel Eng. Driven                                                      | Jockey Pumps                            | Booster Pumps, if required   |
|---------|------------------------------|---|---------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------|------------------------------|
| 1.00.00 | Service                      | : | a) ←- Fire Hydrant System →                 |                                                                         | For Pressurization of fire water system | Fire Hydrant & Spray System  |
|         |                              |   | b) ← Fire spray water system →              |                                                                         |                                         |                              |
| 2.00.00 | Duty                         | : | ←----- Intermittent -----→                  |                                                                         |                                         |                              |
| 3.00.00 | Location                     | : | ←----- Indoor -----→                        |                                                                         |                                         |                              |
| 4.00.00 | Number of Pumps Required     | : | a) Hydrant Pump – 1 No.                     | Hydrant Pump – 2 Nos. Out of two one (1) is standby for hydrant system. | Two (motor driven)                      | Two nos. for individual area |
|         |                              |   | b) High Velocity Water Spray Pump – 1 No    | Common standby for HVW & MVW Spray Water System – 1 No                  |                                         |                              |
|         |                              |   | c) Medium Velocity Water Spray Pump – 1 No. |                                                                         |                                         |                              |
| 5.00.00 | Pump Performance Requirement |   |                                             |                                                                         |                                         |                              |

DEVELOPMENT CONSULTANTS

(e-PCT-TS-K-02-2014-15e-PCT-TS-K-02-2014-15-Vol III-E-Sec-2.doc)

V.III-E/S-II : 43

|                                                              |   | Elec. Motor Driven                               | Diesel Eng. Driven | Jockey Pumps                                     | Booster Pumps, if required                       |
|--------------------------------------------------------------|---|--------------------------------------------------|--------------------|--------------------------------------------------|--------------------------------------------------|
| a) Performance standard                                      | : | <----- Hydraulic institute standard ----->       |                    |                                                  |                                                  |
| b) Rated capacity (Cu.m/hr.)                                 | : | 410                                              | 410                | By Bidder                                        | By Bidder                                        |
| c) Total head, (MLC) not less than                           | : | Bidder shall decide to meet TAC/LPA requirements |                    | Bidder shall decide to meet TAC/LPA requirements | Bidder shall decide to meet TAC/LPA requirements |
| d) Rated speed (rpm) Max.                                    | : | <----- 1500 ----->                               |                    |                                                  |                                                  |
| e) Permissible tolerance in rated capacity (%)               | : | <----- As per IS : 5120 ----->                   |                    |                                                  |                                                  |
| f) Permissible tolerance in efficiency at rated capacity (%) | : | <----- No negative tolerance ----->              |                    |                                                  |                                                  |
| g) Range of operation                                        | : | <----- 25% to 130%----->                         |                    |                                                  |                                                  |
| 6.00.00 Design standard                                      | : | <-----HIS/ IS 5120/Equivalent Standard----->     |                    |                                                  |                                                  |
| 7.00.00 Impeller type                                        | : | <-----Semi open----->                            |                    |                                                  |                                                  |
| 8.00.00 Type of gland lubrication and sealing                | : | <-----By Bidder----->                            |                    |                                                  |                                                  |
| 9.00.00 Shaft sealing arrangement                            | : | <----- Mechanical seal ----->                    |                    |                                                  |                                                  |

**DEVELOPMENT CONSULTANTS**

(e-PCT-TS-K-02-2014-15e-PCT-TS-K-02-2014-15-Vol III E-Sec-2.doc)

**V.IIIE/S-II : 44**

|          |                                                                            | Elec. Motor Driven | Diesel Eng. Driven                          | Jockey Pumps | Booster Pumps, if required |
|----------|----------------------------------------------------------------------------|--------------------|---------------------------------------------|--------------|----------------------------|
| 10.00.00 | Axial thrust balancing device to be designed for pump shut-off operation : |                    | ←----- Yes -----→                           |              |                            |
| 13.00.00 | Type of pump-motor connection :                                            |                    | ←-----Direct -----→                         |              |                            |
| 14.00.00 | Type of coupling :                                                         |                    | ←----- Flexible Coupling -----→             |              |                            |
| 15.00.00 | Mode of pump starting :                                                    |                    | ←-- Discharge valve fully open ---→         |              |                            |
| 16.00.00 | Material of Construction                                                   |                    |                                             |              |                            |
| a)       | Casing :                                                                   |                    | ← 2.5% NiCl as per IS:210 Gr. FG 260 →      |              |                            |
| b)       | Casing liner :                                                             |                    | ←----- Do -----→                            |              |                            |
| c)       | Impeller :                                                                 |                    | <-----ASTM - A 743 GR. CF 8 M-----→         |              |                            |
| d)       | Wearing rings :                                                            |                    | <----- SS-304 -----→                        |              |                            |
| e)       | Pump shaft :                                                               |                    | ←----- AISI 410 (Hardened) -----→           |              |                            |
| f)       | Gland :                                                                    |                    | ← 2.5% NiCl as per IS:210 Gr. FG 260 →      |              |                            |
| g)       | Base plate :                                                               |                    | ←----- Carbon Steel as per IS-2062 -----→   |              |                            |
| h)       | Mechanical Seal :                                                          |                    | <----- As per Manufacturer's Standard-----→ |              |                            |
| i)       | Wetted Fastners :                                                          |                    | ←----- SS-316 -----→                        |              |                            |

|          |                                                                       | Elec. Motor Driven | Diesel Eng. Driven                        | Jockey Pumps | Booster Pumps, if required |
|----------|-----------------------------------------------------------------------|--------------------|-------------------------------------------|--------------|----------------------------|
|          | j) Companion Flange :                                                 |                    | ←----- Carbon Steel as per IS-2062 -----→ |              |                            |
| 17.00.00 | Supply of accessories & services                                      |                    |                                           |              |                            |
|          | a) Base plate :                                                       |                    | ←----- Yes -----→                         |              |                            |
|          | b) Foundation bolts, nuts, sleeves etc. :                             |                    | ←----- Yes -----→                         |              |                            |
|          | c) Suction & Discharge companion flanges with bolts, nuts & gaskets : |                    | ←----- Yes -----→                         |              |                            |
|          | d) Priming connection with 3 way SS isolating valve :                 |                    | ←----- Yes -----→                         |              |                            |
|          | e) Suction & Discharge pressure indicator :                           |                    | ←----- Yes -----→                         |              |                            |
|          | f) Vent with 3 way SS isolating valve :                               |                    | ←----- Yes -----→                         |              |                            |
|          | g) Pump-motor coupling and guard :                                    |                    | ←----- Yes -----→                         |              |                            |
|          | h) Drain connection with valve                                        |                    | ←----- Yes -----→                         |              |                            |
|          | i) Eye-bolts, lifting tackle etc. :                                   |                    | ←----- Yes -----→                         |              |                            |

**ANNEXURE-II**

**DATA SHEET  
FOR  
DIESEL ENGINE**

**1.00.00 GENERAL INFORMATION**

|         |                        |   |                                                                                                                            |
|---------|------------------------|---|----------------------------------------------------------------------------------------------------------------------------|
| 1.01.00 | Service                | : | Plant Service Water Pump House                                                                                             |
| 1.02.00 | Designation            | : | Internal combustion Diesel Engine.                                                                                         |
| 1.03.00 | Type                   | : | Compression ignition, mechanical (air less) direct injection, multi cylinder and four stroke cycle and cold starting type. |
| 1.04.00 | No. of engine required | : | Three (3)                                                                                                                  |
| 1.05.00 | Duty                   | : | Intermittent                                                                                                               |
| 1.06.00 | Location               | : | Indoor                                                                                                                     |

**2.00.00 ENGINE PARAMETERS**

|         |                                                                     |   |                                                 |
|---------|---------------------------------------------------------------------|---|-------------------------------------------------|
| 2.01.00 | Nominal output of engine at site operating under ambient conditions | : | Bidder to indicate during detailed engineering. |
| 2.02.00 | Speed of the engine                                                 | : | Not more than 2300 rpm.                         |



**ANNEXURE-V**

**DATA SHEET  
FOR  
PIPING, FITTINGS, VALVES AND SPECIALTIES**

**A. PIPING AND FITTINGS**

|         |                  |                                                                                                                                                                                                                                                                                           |                                         |                                                                                               |                                 |
|---------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------|
| 1.00.00 | Type             | Buried pipes                                                                                                                                                                                                                                                                              | Overground pipes normally full of water | Overground pipes normally empty but periodically charge with water & foam system applications | Overground compressed air pipes |
|         |                  | (i)                                                                                                                                                                                                                                                                                       | (ii)                                    | (iii)                                                                                         | (iv)                            |
| 2.00.00 | Material         | M. S. ERW pipes as per IS-1239, Part – 1 heavy grade (for pipes of sizes 150 mm NB or below) and IS-3589 Gr.410 ERW (For sizes 200 mm NB and above) or equivalent and galvanized as per IS 4736 for pipes normally empty and periodically charged with water and foam system application. |                                         |                                                                                               |                                 |
| 3.00.00 | Piping Thickness | Pipes for sizes 200 NB & above shall conform to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below.                                                                                                                         |                                         |                                                                                               |                                 |
|         |                  | Nominal Pipe Size (mm)                                                                                                                                                                                                                                                                    | Outside Diameter (mm)                   | Wall Thickness (mm)                                                                           |                                 |
|         |                  | 200 NB                                                                                                                                                                                                                                                                                    | 219.1                                   | 6.3                                                                                           |                                 |
|         |                  | 250 NB                                                                                                                                                                                                                                                                                    | 273                                     | 6.3                                                                                           |                                 |
|         |                  | 300 NB                                                                                                                                                                                                                                                                                    | 323.9                                   | 7.1                                                                                           |                                 |
|         |                  | 350 NB                                                                                                                                                                                                                                                                                    | 355.6                                   | 8.0                                                                                           |                                 |
|         |                  | 400 NB                                                                                                                                                                                                                                                                                    | 406.4                                   | 8.0                                                                                           |                                 |
|         |                  | 450 NB                                                                                                                                                                                                                                                                                    | 457                                     | 8.0                                                                                           |                                 |
|         |                  | 500 NB                                                                                                                                                                                                                                                                                    | 508                                     | 8.0                                                                                           |                                 |
|         |                  | 600 NB                                                                                                                                                                                                                                                                                    | 610                                     | 8.0                                                                                           |                                 |
| Note :  | a)               | To prevent soil corrosion buried pipes shall be properly lagged with two coat and corrosion protective tapes of minimum thickness of 4 mm (in two layers) of coal tar type as per AWWA C 203 / IS :15337.                                                                                 |                                         |                                                                                               |                                 |
|         | b)               | Over-ground pipes normally empty but periodically charged with water, foam system applications & compressed air shall be galvanized as per IS : 4736. These pipes shall be provided with one coat of primer and three coats of chlorinated rubber paint.                                  |                                         |                                                                                               |                                 |

|         |                        |                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |
|---------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| 3.00.00 | Size                   | As per final design and engineering by Bidder and approved by Owner. However Bidder shall consider velocity of fluid in the pipeline & other criteria as indicated elsewhere for selection of pipe size.                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |
| 4.00.00 | Construction           | <div>←----- ERW -----→</div> <div>(i) (ii) (iii) (iv)</div>                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |
| 5.00.00 | Joints                 | Butt-welded for size 65 mm NB & higher as per ANSI B 16.9 and socket welded for sizes up to 50 m NB as per ANSI B16.11                                                                                                                                             | Screwed flange as required for dismantling purposes for sizes 65 mm NB & above as per ANSI B 16.5 and screwed socket for sizes 50 mm NB & below.<br><br>Welding on GI Pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by the employer. After welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further the contractor shall provide proper zinc paint at the point of welding. |  |  |
| 6.00.00 | Fittings               |                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |
|         | Ratings/Wall thickness | Minimum thickness to match with that of pipe for pipe size 65 mm NB and above. For pipe size above 150 mm NB, minimum thickness shall be 6 mm. For pipe size 50 mm NB & below rating shall be 3000 lbs or wall thickness matching with that of corresponding pipe. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |
|         | Material               | The material shall conform to ASTM A234 Gr. WPB or ASTM A 105 or equivalent.                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |

**Note :**

- 1) All fittings and flanges for galvanized pipes shall be galvanized.
- 2) Unless otherwise specified, all elbows/bends shall be long radius type.
- 3) The fittings shall be galvanized as per IS: 4736 for galvanized pipe application. In case of branching connections from GI mains for spray piping network socket may be welded for more than two pipe reductions instead of standard tees.

- 4) Fabricated fittings shall not be acceptable up to pipe size of 300 NB. For sizes 350 NB & above, fittings may be fabricated as per BS: 2633/BS: 534.
- 5) Working and test pressure of piping & fittings shall be as per IS or relevant international standards.

## **B. VALVES**

### **I. Gate, Globe & Check Valve**

#### **1. Basic Design Code**

- |    |             |   |     |                                          |
|----|-------------|---|-----|------------------------------------------|
| a) | Gate Valve  | : | i)  | IS-14846 for sizes 65 mm NB to 300 mm NB |
|    |             |   | ii) | IS-2906 for sizes 350mm NB and above     |
| b) | Globe Valve | : |     | BS EN-13789                              |
| c) | Check Valve | : |     | BS-1868                                  |

#### **2. Construction : Cast body and bonnet/cover.**

#### **3. Material of Construction for Gate and Globe Valve**

- |    |                                                                            |   |                                         |
|----|----------------------------------------------------------------------------|---|-----------------------------------------|
| a) | Body and bonnet Material for Gate and Globe valve cover IS-210 Gr. FG 260. |   |                                         |
| b) | Trim/disc.                                                                 | : | IS-210 Gr. FG 260.                      |
| c) | Stem                                                                       | : | Stainless steel to AISI-410 13% Cr. St. |

#### **4. Material of Construction of Check Valve shall be as given below:**

- |    |                       |   |                                                                                         |
|----|-----------------------|---|-----------------------------------------------------------------------------------------|
| a) | Body, Bonnet & Cover  | : | ASTM-A-216 Gr. WCB                                                                      |
| b) | Trim/Disc             | : | 13% Cr. Steel as per ASTM-A-182 Gr. F6 Heat treated and Hardened, min. Hardness-250 HB. |
| c) | Back seat & Hinge Pin | : | 13% Cr. Steel as per ASTM-A-182 Gr. F6.                                                 |

Note: Gate, globe and check valve of size 50 mm NB & below shall be of forged CS body as per API 602(Gate valve), BS 1868(Check valve) and BS 1873(Globe valve). These valves shall have socket welded ends. Valves will be provided with locking arrangements.

### **II. Deluge Valve**

## ANNEXURE-IX

### Technical Specifications for Nitrogen Gas Injection System for Oil Filled Transformer

#### 1. Operation Controls

The system is to be provided with automatic control for fire protection and fire extinction, beside automatic control remote electrical push button control on control box and local manual control in the fire-extinguishing cubicle is provided.

#### 2. System Activating Signals

Transformer isolation through master trip relay or circuit breaker (HV & LV in series). Besides, two electrical signals to be provided in series, for activating the system as under:

- i) For prevention :  
Differential relay  
Buchholz Relay paralleled with pressure relief valve or RPRR.
- ii) For Extinction :  
Fire Detector  
Buchholz Relay paralleled with pressure relief valve or RPRR.

#### 3. System Equipment

- A. Fire extinguishing cubicle (FEC) to be placed on plinth at about minimum 5 meter away from the transformer, shall consist of:
  - i) Nitrogen cylinder with regulator and falling pressure electrical contact manometer.
  - ii) Oil drainpipe with mechanical quick drain valve.
  - iii) Electro mechanical control equipments for oil drain and predetermined regulated nitrogen release.
  - iv) Pressure monitoring switch for back up protection for nitrogen release.
- B. Control box with activating, monitoring devices and line faults indicators (to be placed in the control room).
- C. Pre-stressed non-return valve (PNRV) to be fitted in the conservator pipe line, between conservator and buchholz relay operating mechanically on transformer oil flow rate with electrical signal for monitoring.
- D. Fire detectors to be fixed on transformer tank top cover for sensing fire.
- E. Signal box to be fixed on transformer sidewall for terminating cable connections from fire detectors and PNRV.

4. **Other Requirements for System Installation**

- A. Oil drain and nitrogen openings with gate valve on transformer tank, flanges with dummy piece in conservator pipe and fire detector brackets on transformer top cover.
- B. Spare potential free contacts for system activating signals i.e. Differential relay, Buchholz relay, PRV/ RPRR, Transformer isolation.
- C. Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.
- D. Cabling on transformer top cover. All fire detector to be connected in parallel and inter cabling between signal box to control box and control box to FEC.
- E. Plinth for FEC, Oil pit with capacity as 10% of total oil quantity of transformer.

5. **Technical Details**

Fire Extinction Period

On Commencement of Nitrogen injection: Maximum 30 seconds

On system activation up to post cooling: Maximum 3 minutes

Fire Detectors heat sensing temperature: 141 ° C

Heat Sensing Area: 800 mm radius

Pre-stressed non-return valve setting for operation: Minimum 60 litre per minute.

6. **Power Source**

Control Box: 220V DC

Fire Extinguishing cubicle: 240V AC, 40W

7. **Cabling**

Fire survival cables 4 C x 1.5 mm <sup>2</sup> for connection of fire detectors in parallel.

Fire survival cable 12 C x 1.5 mm <sup>2</sup> for connection between transformer signal box/ marshalling box to control box and control box to FEC.

Fire survival cable 4 C x 1.5 mm <sup>2</sup> for connection between control box to DC supply source and FEC to AC supply source, signal box/ marshalling box to pre-stressed non-return valve connection on transformer.

**SCOPE OF SUPPLY & INSTALLATION ACTIVITIES FOR NITROGEN INJECTION FIRE  
PROTECTION SYSTEM FOR TRANSFORMER**

**A. System Equipments**

1. Fire extinguishing cubicle with base frame and containing oil drain assembly, nitrogen cylinder, electro mechanical control unit for oil drain and nitrogen release, pressure monitoring switch for back up protection for release of nitrogen, detectors necessary for monitoring system, flanges with gate/ butterfly valves on top panel for connecting pipe connections from transformer, panel lighting etc.
2. Control box for monitoring system operation, automatic control and remote operation, with alarms, indication light switches, push buttons, audio signals, line fault detection suitable for tripping and signaling on 220V DC supply.
3. Pre-Stressed non-return valve (PNRV) working mechanically on transformer oil flow rate, with proximity switch for remote alarm indication and with visual position indicator.
4. Required no. of fire detectors rated for 141°C for heat sensing each fitted with two number cable glands.
5. Signal box for terminating cable connections from PNRV and fire detectors.

**B. Other Material Requirements**

1. FRLS cable 4 C x 1.5 mm<sup>2</sup> for fire detector connections.
2. Fire survival cables 12 C x 1.5 mm<sup>2</sup> for connections between transformer - control box.
3. Fire survival cables 4 C x 1.5 mm<sup>2</sup> for signals from relay panels to control box, panel lighting, PNRV connections on transformer etc.
4. Pipe connections between transformer and FEC, ERW class 'C' pipes with bends, flanges, other fittings and gate/ butterfly valves as required.
5. Pipe connections with fittings for connection between FEC – oil pit.
6. Mandatory Spares: 1 No. spare N<sub>2</sub> cylinder for each sub station 3 No. Heat Sensors for each system 1 set Hose pipes with fittings.

**C. Installation of System**

**1. Civil Work**

- i) Plinth for fire extinguishing cubicle.

**2. Pipe Connections between Transformer, FEC and Oil Pit**

- i) Oil drainpipe connections between outlet valve provided on the transformer tank and the flanges provided on FEC top panel.
- ii) Drainpipe connections between oil drainpipe bottom (in FEC) to the oil pit.

- iii) Nitrogen injection pipe connections between inlet openings on transformer tank and flange provided on FEC top panel.

### 3. Cabling

- i) Connecting all fire detectors in parallel and terminating in signal box, using fire survival cables 4 C x 1.5 mm<sup>2</sup> cable.
- ii) Connecting PNRV to signal box, using Fire survival cables 4C x 1.5 mm<sup>2</sup>
- iii) Connections to FEC for 230V AC single-phase panel light supply, using fire survival cables 4C x 1.5 mm<sup>2</sup>
- iv) Connections from relay panel to control box using fire survival cables 4Cx1.5mm<sup>2</sup>
- v) Connections from DC source to control box directly or through DC-DC connector, using fire survival cables 4C x 1.5 mm<sup>2</sup>
- vi) Connections between signal box to control box and between control box to FEC using fire survival cables 12 C x 1.5 mm<sup>2</sup>

### D. Pre-Commissioning Tests

Pre-Commissioning tests shall be carried out jointly by system manufacturer and the purchaser or his representative prior to commissioning the system.

**Note: This system shall be provided in addition to the Spray System for the transformers**

**VOLUME: V-A**

**SECTION-II**

**TECHNICAL SPECIFICATION  
FOR  
A.C. & D.C. MOTORS**



## CONTENT

| CLAUSE NO. | DESCRIPTION              |
|------------|--------------------------|
| 1.00.00    | SCOPE                    |
| 2.00.00    | CODES & STANDARDS        |
| 3.00.00    | SERVICE CONDITIONS       |
| 4.00.00    | TYPE AND RATING          |
| 5.00.00    | PERFORMANCE              |
| 6.00.00    | SPECIFIC REQUIREMENTS    |
| 7.00.00    | ACCESSORIES              |
| 8.00.00    | TESTS                    |
| 9.00.00    | DRAWINGS, DATA & MANUALS |

### ATTACHMENT

|            |             |
|------------|-------------|
| ANNEXURE-A | DESIGN DATA |
|------------|-------------|

**VOLUME: V-A**

**SECTION-II**

**TECHNICAL SPECIFICATION  
FOR  
A.C. & D.C. MOTORS**

- 1.00.00      **SCOPE**
- 1.01.00      This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00      Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00      In case of any discrepancy, the driven equipment specification shall govern.
- 2.00.00      **CODES & STANDARDS**
- 2.01.00      All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00      Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:
- i)      IS-325
  - ii)      IS-12615
  - iii)      IEC-60034
- 3.00.00      **SERVICE CONDITIONS**
- 3.01.00      The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.
- 3.02.00      Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00      For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
- 4.00.00      **TYPE AND RATING**
- 4.01.00      **A.C. Motors**
- 4.01.01      Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.
- 4.02.00 **D.C. Motors**
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.
- 4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- Starter panel complete with all accessories shall be included in the scope of supply.
- 5.00.00 **PERFORMANCE**
- 5.01.00 **Running Requirements**
- 5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 **Starting Requirements**
- Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-
- |                     |   |                                             |
|---------------------|---|---------------------------------------------|
| Motors up to 1500kW | - | 600% subject to IS tolerance of plus 20%.   |
| Motors above 1500kW | - | 450% not subject to any positive tolerance. |
- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.
- 5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.
- b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

- 6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygrosopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**

- 6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.
- 6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.
- 6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

| Voltage Rating of Motor |   | Minimum Ph-Ph & Ph-Earth clearance |
|-------------------------|---|------------------------------------|
| 0.415 kV                | : | 25 mm                              |
| 3.3 kV                  | : | 65 mm                              |
| 11.0 kV                 | : | 140 mm                             |

**Note:** In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

**6.08.00 Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

| Rating |        | Conductor Size |                      |
|--------|--------|----------------|----------------------|
| Above  | Up to  |                |                      |
| -----  | 5.5 kW | :              | 8 SWG GI Wires.      |
| 5.5 kW | 22 kW  | :              | 25mm X 4mm GS Flat.  |
| 23 kW  | 55 kW  | :              | 40mm X 6mm GS Flat.  |
| 56kW   | 174kW  | :              | 50mm X 8mm GS Flat.  |
| 175kW  | ABOVE  | :              | 75mm X 10mm GS Flat. |

6.08.03 The cable terminal box shall have a separate grounding pad.

**6.09.00 Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

| Rating |         | : | Cable Size          |
|--------|---------|---|---------------------|
| Above  | Up to   |   |                     |
| -----  | 5.5 kW  | : | 1R X 3C X 6 Sq.mm   |
| 5.5 kW | 11 kW   | : | 1R X 3C X 10 Sq.mm  |
| 11 kW  | 22 kW   | : | 1R X 3C X 35 Sq.mm  |
| 22 kW  | 37.5 kW | : | 1R X 3C X 70 Sq.mm. |
| 37.5kW | 55 kW   | : | 1R X 3C X 150 Sq.mm |
| 55 kW  | 75 kW   | : | 1R X 3C X 300 Sq.mm |
| 75 kW  | 110kW   | : | 2R X 3C X 150 Sq.mm |
| 110 kW | 175kW   | : | 2R X 3C X 300 Sq.mm |

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

| Rating |       | : | Cable Size |
|--------|-------|---|------------|
| Above  | Up to |   |            |

|         |           |   |                       |
|---------|-----------|---|-----------------------|
| 175 kW  | 1000 kW   | : | 1R X 3C X 240 Sq.mm   |
| 1000 kW | 2000 kW   | : | 2R X 3C X 240 Sq.mm   |
| 2000 kW | 4500 kW   | : | 2R X 3C X 300 Sq.mm   |
| 4501 kW | 10,000 kW | : | 9R X 1C X 1000 Sq.mm. |

**Note:** During detail engineering if higher cable size is required same shall be provided.

#### 6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

#### 7.00.00 **ACCESSORIES**

##### 7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

##### 7.02.00 **Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

- i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).
- ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

##### 7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.



- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V and 3300V motor bearing temperature.
  - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.
- 7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition, any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

| Voltage rating of motor | Impulse Test Voltage |
|-------------------------|----------------------|
| 3.3 kV                  | 18 kV peak           |
| 11 kV                   | 49 kV peak           |

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS: 7816 as routine test
- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.
- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.

- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.
- k. Over speed test as routine test.
- l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

| Specified Design<br>Ambient temperature | Thermometer Method | Resistance Method |
|-----------------------------------------|--------------------|-------------------|
| 50 deg.C                                | 60 deg.C           | 70 deg.C          |
| 45 deg.C                                | 65 deg.C           | 75 deg.C          |
| 40 deg.C                                | 70 deg.C           | 80 deg.C          |

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

**9.00.00 DRAWINGS, DATA & MANUALS**

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

**9.02.00 To be Submitted with the bid**

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write-up on forced lubrication system, if any
- d) Type test report

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

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

**ANNEXURE-A**

**DESIGN DATA**

**1.0 AUXILIARY POWER SUPPLY**

| Supply          | Description                                                                                     | Consumer                                                                                                   |
|-----------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| H.V. Supply     | 11000 V, 3Ø, 3W, 50 Hz,<br>Non-effectively earthed<br><br>Fault level 44 kA symm.<br>for 1 sec. | Motors 1500 kW & above                                                                                     |
| M.V. Supply     | 3300 V, 3Ø, 3W, 50 Hz,<br>Non-effectively earthed<br><br>Fault level 40 kA symm.<br>for 1 sec.  | Motors 175 kW and<br>Up to less than 1500 kW.                                                              |
| L.V. Supply (i) | 415V, 3Ø, 3W, 50 Hz<br>effectively earthed<br><br>Fault level 50 kA symm.<br>for 1 sec.         | Motors above 0.2kW<br>and below 175kW.                                                                     |
| (ii)            | 240V AC/415V AC<br><br>240V, 1Ø, 2W, 50 Hz<br>effectively earthed                               | Motors upto 0.2kW.<br><br>Lighting, Space heat-<br>ing , A.C supply for Contr-<br>ol & protective devices. |
| D.C. Supply     | 220V, 2W, unearthed<br><br>Fault level 25* kA.<br>for 1 sec.                                    | D.C. alarm, control<br>& protective devices                                                                |

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

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

**2.0 RANGE OF VARIATION**

**A.C. Supply :**

|                           |   |                    |
|---------------------------|---|--------------------|
| Voltage                   | : | $\pm 10\%$         |
| Frequency                 | : | +3% to -5%         |
| Combined Volt + frequency | : | 10% (absolute sum) |

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

**D.C. Supply :**

|         |   |                 |
|---------|---|-----------------|
| Voltage | : | 187 to 242 Volt |
|---------|---|-----------------|

**VOLUME : V-A**

**SECTION-I**

**GENERAL ELECTRICAL SPECIFICATION**

## CONTENT

| CLAUSE NO.     | DESCRIPTION                             |
|----------------|-----------------------------------------|
| <b>1.00.00</b> | <b>GENERAL REQUIREMENT</b>              |
| 1.01.00        | General                                 |
| 1.02.00        | Codes & Standards                       |
| 1.03.00        | Environmental Conditions                |
| 1.04.00        | Auxiliary Voltages                      |
| 1.05.00        | Equipment Protection                    |
| 1.06.00        | Type & Rating of Equipment              |
| 1.07.00        | Control Philosophy                      |
| 1.08.00        | Scheme for Auxiliary Power Distribution |
| 1.09.00        | Islanding Scheme                        |
| 1.10.00        | Power Evacuation                        |
| 1.11.00        | Insulation Level                        |
| 1.12.00        | Neutral Grounding                       |
| 1.13.00        | Motor Voltage                           |
| 1.14.00        | Tropical Protection                     |
| 1.15.00        | Enclosure Protection                    |
| 1.16.00        | Painting for Electrical Equipment       |
| 1.17.00        | Redundancy                              |
| 1.18.00        | Quality Assurance                       |
| 1.19.00        | Drawings/ Documents for Approval        |
| <b>2.00.00</b> | <b>SCOPE OF SUPPLY &amp; WORK</b>       |
| 2.01.00        | General                                 |
| 2.02.00        | Generator & Auxiliary System            |
| 2.03.00        | Generator Busduct & MV Busduct          |
| 2.04.00        | Generator Circuit Breaker               |
| 2.05.00        | Transformers                            |
| 2.06.00        | Switchgears                             |
| 2.07.00        | DC System                               |
| 2.08.00        | Motors                                  |
| 2.09.00        | Electrical Actuators                    |
| 2.10.00        | Variable Frequency Drives               |
| 2.11.00        | Cabling                                 |
| 2.12.00        | Cables                                  |
| 2.13.00        | Grounding & Lightning Protection        |
| 2.14.00        | Station Lighting                        |
| 2.15.00        | DG Set                                  |
| 2.16.00        | EHV Switchyard                          |
| 2.17.00        | Energy Management System                |
| 2.18.00        | Erection & Testing Equipment            |
| 2.19.00        | Construction Power                      |
| 2.20.00        | Type Test                               |

---

### DEVELOPMENT CONSULTANTS

(e-PCT/TS/K/02/2014-15/V-A/SEC-I)

|                |                                                  |
|----------------|--------------------------------------------------|
| 2.21.00        | Mandatory Spares                                 |
| 2.22.00        | Scope of Design Work                             |
| <b>3.00.00</b> | <b>LAYOUT CRITERIA</b>                           |
| 3.01.00        | Transformer Yard                                 |
| 3.02.00        | Criteria of Oil Pit for Transformer              |
| 3.03.00        | Layout Requirement for BOP Auxiliary Buildings   |
| 3.04.00        | Equipment Layout                                 |
| 3.05.00        | Interplant Cable Routing                         |
| <b>4.00.00</b> | <b>SIZING CRITERIA</b>                           |
| 4.01.00        | Generator                                        |
| 4.02.00        | Generator Transformer                            |
| 4.03.00        | Unit & Standby Transformers                      |
| 4.04.00        | Auxiliary and LT Transformers                    |
| 4.05.00        | Bus ducts and Cables                             |
| 4.06.00        | DC System                                        |
| 4.07.00        | DG Set                                           |
| 4.08.00        | UPS System                                       |
| 4.09.00        | Electrical Laboratory Equipment                  |
| <b>5.00.00</b> | <b>PROVEN-MAKE CRITERIA</b>                      |
| 5.01.00        | Isolated Phase Busduct                           |
| 5.02.00        | Power Transformers                               |
| 5.03.00        | Auxiliary Oil Filled /Dry type Transformers      |
| 5.04.00        | 11 kV & 3.3kV Switchgears                        |
| 5.05.00        | LT Switchgear                                    |
| 5.06.00        | Numerical Relays & Networking                    |
| 5.07.00        | HT Motor                                         |
| 5.08.00        | LT Control Cables                                |
| 5.09.00        | LT Power Cables                                  |
| 5.10.00        | HT Cables                                        |
| 5.11.00        | DG Sets                                          |
| 5.12.00        | DC Batteries                                     |
| 5.13.00        | Battery Charger                                  |
| 5.14.00        | Generator Circuit Breaker                        |
| 5.15.00        | 400kV Switchyard Equipment (AIS)                 |
| 5.16.00        | Substation Automation System & Protective Relays |

## ATTACHMENTS

ANNEXURE – A      TECHNICAL PARAMETERS OF ELECTRICAL SYSTEM

---

### DEVELOPMENT CONSULTANTS

(e-PCT/TS/K/02/2014-15/V-A/SEC-I)



**VOLUME : V-A  
SECTION-I  
GENERAL ELECTRICAL SPECIFICATION**

**1.00.00 GENERAL REQUIREMENT**

**1.01.00 General**

1.01.01 Contractor shall provide fully compatible electrical system, equipments, accessories and services for the entire station/plant in his scope as well as those specifically required by the Owner.

1.01.02 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, in particular the Indian Statutory Regulations.

1.01.03 Drawings and annexure appended to this specification shall form part of this specification and supplement the requirements specified herein. This specification shall be read and construed in conjunction with the drawings and annexure to determine the scope of work and terminal points.

1.01.04 It is not the intent to specify completely herein all details of the system or equipment. Nevertheless, the system/equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.

1.01.05 Any system, material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished without any commercial implication to the Owner.

1.01.06 In case of a conflict between this Section (GENERAL ELECTRICAL SPECIFICATION) and the other Sections of Volume V-A & Volume V-B, the stipulation under this Section shall prevail, unless the Owner advises otherwise on a specific issue at the Bidding stage.

**1.01.07 Proposal Data Sheets**

The Proposal Data Sheets annexed to this specification shall be filled in without any ambiguity by typing in appropriate place on each page. These pages must be properly signed by authorized representative of the Bidder as verification of the data and submitted along with the bid to form part of the Bidder's formal proposal.

**1.01.08 Guaranteed Performance**

The performance figures quoted in Technical Particular Sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection at any stage.

**1.01.09 Deviation**

Should the Bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation. All such deviations shall be clearly mentioned on the Deviation sheet enclosed, with reference to the respective clause of the specification. Unless such deviations are recorded in the Deviation sheets and submitted with the offer, it shall be taken for granted that the offer is made in conformity with this specification in all respects.

- 1.01.10      Drawing Approval
- Before starting manufacture of any equipment, the contractor shall have to take approval of relevant drawings and data from Engineer in writing. Any manufacture done prior to the approval of drawings/data shall be rectified in accordance with the approved drawings/data by the Contractor at his own cost and the equipment shall be supplied within the stipulated period.
- 1.01.11      Site Condition
- For the purpose of equipment design, reference ambient temperature shall be taken as 50°C. Other site conditions shall be as indicated in the Lead Specification.
- 1.01.12      The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined elsewhere in the specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional financial liability to the Owner.
- 1.01.13      Transformer voltage ratios, taps, impedances and tolerances thereon, shall be so optimized so that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of large motors such as MDBFP etc. The vector groups of the transformers shall be so selected that all the buses of particular voltage level have same vector throughout the plant.
- 1.01.14      Responsibility of coordination with electrical agencies /TAC/Pollution control board/Electrical Inspectorate and obtaining all necessary clearances shall be of the contractor.
- 1.01.15      Special Tools & Tackles
- A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.
- The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.
- 1.01.16      Spares
- (a)      The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.
- (b)      The Bidder shall quote and supply mandatory spare parts as per list attached in Vol. IIA, Sec.8. The final quantity shall be decided during placement of order.
- (c)      Each list shall be complete with specification, make, identification number, unit rate, quantity etc.
- 1.02.00      **Codes & Standards**
- 1.02.01      Equipment
- Requirement of conformance with Codes and Standards is described in individual Sections.

1. 02.02      **Installation**
- All electrical installation work shall comply with the provisions of the Indian Electricity Act, the Indian Electricity Rules as amended up to date, relevant IS Codes of Practice and recommendations of the Tariff Advisory Committee (TAC). In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rules shall be binding.
1. 02.03      Nothing in this enquiry specification shall be construed to relieve the Contractor of his responsibility to abide by the Standards or Codes.
- 1.03.00      **Environmental Conditions**
- 1.03.01      The equipment will be installed in hot humid and tropical atmosphere highly polluted with coal dust and fly ash.
- 1.03.02      Sensitive relay and other electrical and electronic devices shall be located in controlled environment such as control room, electronic equipment room etc. as applicable.
- 1.03.03      For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.
- 1.04.00      **Auxiliary Voltages**
- 1.04.01      Auxiliary AC voltage supply arrangement shall have 11 kV, 3.3 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition:
- a)      HT & LT AC System      -       $\pm 10\%$
  - b)      220V DC                      -      -15% to +10%
- 1.04.02      Following auxiliary voltages will be envisaged for LT auxiliary power, control and instrumentation.
- a)      240 V  $\pm 10\%$ , 1 Ph, 50 Hz +3% to -5%
  - b)      220 V DC +10% to (-) 15%, two wire, ungrounded
  - c)      240 V, 1 Ph, 50 Hz, UPS System
  - d)      24 V / 48 V DC, as required
- 1.04.03      Nominal voltage of main DC system shall be 220V. DC batteries shall be designed for continuous float operation with trickle charging, hence all the associated components like batteries, battery chargers, DC motors, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous battery float voltage including suitable temperature correction factors.
- In addition, the bidder may propose 48V or 24V systems as per requirements of control and instrumentation of his equipment and design.
- 1.05.00      **Equipment Protection**
- 1.05.01      The Contractor shall design the plant with the primary objective to mitigate the damage of the plant and equipment during fault or system disturbances.

- 1.05.02 Automatic trip functions will be initiated for isolation of fault, which could cause immediate and severe damage.
- 1.05.03 Every effort shall be made to avoid unnecessary trip. There will be annunciation to alert the operator to take corrective action in time.
- 1.05.04 At least two protective devices, preferably operating in parallel on different principles, will be utilized in protecting major equipment, where possible.
- 1.05.05 Major protections envisaged for various equipment are listed under relevant sections of this specification.
- 1.06.00 **Type & Rating of Equipment**
- 1.06.01 Number of types and sizes of standard products like motors, switchgear and control gear components etc. shall be kept to a minimum so that the requirement of spares is reduced.
- 1.06.02 Equipment shall be rated for the load and duty cycle of the intended service Circuit breakers and fuses shall be rated to withstand and interrupt the maximum fault current at the point of application in the circuit.
- 1.07.00 **Control Philosophy for plant Electrical System**
- 1.07.01 In line with the present-day practice centralised control of the electrical system/equipment has been envisaged for the plant. Control of electrical system of main plant and EHV breakers of generator bay shall be provided from DDCMIS with soft HMI. The details of the same are specified in relevant sections of Control and Instrumentation.
- 1.07.02 Generator will be controlled from Central Control Room in the Power House. However, bus selection for generator shall be done from Switchyard Control Room by operation of associated disconnecting switches.
- 1.07.03 400kV side of Standby Transformer feeder, when fed from 400kV switchyard, shall be controlled from Switchyard Control Room. OLTC control for such Standby Transformer shall also be done from Switchyard Control Panel.
- 1.07.04 Control & metering of Generator, GT, UT, ST etc. will be from Central Operating Console as well as from ECP. The protection of above shall be effected through redundant (2x100%) numerical protection relays. Separate set of CTs & PTs shall be used for implementation of such redundancy. Protection of GT, ST, UT shall be achieved through discrete numerical relay protection. Two (2) groups of different make numerical protection relays shall be adopted for Generator protection relays.
- 1.07.05 The control, indication, metering and monitoring of the electrical auxiliary power distribution system comprising of 11 kV & 3.3 kV circuit breakers (except those for motor feeders), 11/3.6kV Auxiliary transformers, LT transformers, 415 V switchgear breakers for incomers and bus couplers, DG system, etc. shall be achieved from operator's consoles through DDCMIS/PLC and ECP (as applicable). For details relevant section of C & I shall be referred.
- 1.07.06 All equipment/components, viz., transducers, etc. required to interface with plant DDCMIS/PLC system shall be provided in switchgear/control panels. The minimum protection required for different equipment and system are indicated in other Sections.

- 1.07.07 STOP pushbutton shall be provided in the local control panel for motors and this STOP annunciation signal shall be provided to the DDCMIS by hardware connection.
- 1.07.08 Control panels for service systems like Ash, C.W. pumps, ash dyke etc. shall be located in the respective control room. In addition, some local panels shall be provided near respective system/equipment such as boiler feed pump, hydrogen seal oil system, electrostatic precipitator, PMCC, ash dyke PMCC etc.
- 1.07.09 In case of internal faults in the generator transformer both turbine and generator will automatically trip. For faults external to the generator and transformer, the generator transformer breaker will open and the turbine, generator shall operate on house load.
- 1.07.10 Suitable unit interlock and protection scheme shall be developed to ensure safety of equipment and stable operation of the unit within permissible limits. Apart from this, the Generator Transformer, the Unit Transformer and the Standby Transformer have to be provided with necessary safety interlock.
- 1.07.11 In case of tripping of the unit, Fast bus change over scheme is proposed to change supply of the Boiler and the Turbine Auxiliaries from Unit to Standby system automatically and thereby avoiding trip out of the Boiler and providing uninterrupted supply to vital Turbine auxiliaries. Under this 'Fast bus change over' scheme the Boiler shall be operating with 60% HP-LP Bypass even if there is trip out of Turbine & Generator.
- 1.07.12 Suitable operational logic shall be developed to operate and control the unit from Central Control Room along with its sub-group and sub-loop control. House load operation of this Unit has been contemplated.
- 1.08.00 **Scheme For Auxiliary Power Distribution**
- 1.08.01 Owner has chosen 'Generator Circuit Breaker Scheme' for the project as indicated in the Electrical Single Line Diagram enclosed with the specification documents.
- 1.08.02 Auxiliary Power Distribution scheme shown in the attached Electrical Single Line Diagram is for the Bidder's guidance. The Bidder shall develop his own scheme maintaining the reliability and redundancy criteria. It shall be subject to the Owner's acceptance.
- 1.08.03 In order to ensure safe shut down of the plant under emergency condition and to provide backup in case of total power failure, one (1) Diesel Generating set shall be provided.
- 1.08.04 Overall system shall be such that failure of any unit auxiliary like transformer, DC battery, Battery charger and DG set shall not reduce the plant's generating capability or affect the safe shut down requirements of the unit.
- 1.08.05 Wherever plant auxiliary supply is extended outside the plant boundary, suitable isolation through transformer shall be done.
- 1.09.00 **Islanding Scheme**
- The unit shall be designed to operate in islanding mode of operation by tripping all the lines and the unit shall run with the available plant load under such condition. Necessary control philosophy shall be submitted by the Bidder.

1.10.00 **Power Evacuation**

The generated power will be stepped up to 400kV and evacuated through 400KV transmission lines. For new unit at KTPS (Kothagudem), power evacuation will be through 3 nos. new 400kV lines.

1.11.00 **Insulation Level**

The insulation level for the transformer windings and bushings shall be as under :

|                        | Winding                                     |                                                 | Bushing                                      |                                                |
|------------------------|---------------------------------------------|-------------------------------------------------|----------------------------------------------|------------------------------------------------|
| Highest System Voltage | Rated Power Freq. withstand Voltage (kVrms) | Rated lightning Impulse withstand Voltage (kVp) | Rated Power freq. withstand voltage (kV rms) | Rated lighting Impulse withstand Voltage (kVp) |
| 0.433 kV               | 3                                           |                                                 | 3                                            |                                                |
| 3.6 kV                 | 10                                          | 40                                              | 10                                           | 40                                             |
| 7.2 kV                 | 20                                          | 60                                              | 20                                           | 60                                             |
| 12 kV                  | 28                                          | 75                                              | 28                                           | 75                                             |
| 17.5 kV                | 38                                          | 95                                              | 38                                           | 95                                             |
| 24kV                   | 50                                          | 125                                             | 50                                           | 125                                            |
| 36kV                   | 70                                          | 170                                             | 70                                           | 170                                            |
| 72.5 kV                | 140                                         | 325                                             | 140                                          | 325                                            |
| 145kV                  | 275/*                                       | 650                                             | 275                                          | 650                                            |
| 245kV                  | 395*                                        | 950/1050**                                      | 460                                          | 1050                                           |
| 420kV                  | 630/*                                       | 1425/1570**                                     | 630                                          | 1425                                           |

\* In case of non-uniformly insulated (refer IEC 60076-3, Table D.2)

\*\*Chopped Wave BIL

1.12.00 **Neutral Grounding**

1.12.01

Neutral earthing equipment shall be designed duly taking into account the maximum permissible operating voltage of the generator, voltage rise on load throw off (subsequent to detection of earth fault) field suppression time, ferro resonance, etc. The generator shall be grounded through distribution transformer with secondary loading resistor, limiting the earth fault current to about 5-10 A and to restrict the over voltages caused due to capacitive currents. The neutral earthing equipment shall be rated to carry this current for at least 5 minutes considering the generator terminal voltage under maximum field forcing conditions.

1.12.02

11 kV/3.3kV system earthing shall be low resistance earthed type to limit earth fault current to 300A. The resistor shall be rated to carry this current at least for 10 seconds.

400kV system is solidly grounded.

Neutrals of Generator Transformers (on 400kV side) and all LT Transformers (415V) shall be solidly earthed through bolted links.

220V DC system shall be kept ungrounded.

Diesel generator shall also be kept ungrounded (earthing through PT).

#### 1.13.00 **Motor Voltage**

The voltage level for motors shall be as follows:

- |    |                                         |   |                   |
|----|-----------------------------------------|---|-------------------|
| a) | Up to 0.2 kW                            | - | 240V AC / 415V AC |
| b) | Above 0.2 kW and up to less than 175 kW | - | 3 ph, 415V AC     |
| c) | 175 kW and up to less than 1500 kW      | - | 3 ph, 3.3KV AC    |
| d) | 1500 kW & above                         | - | 11 kV             |

415V or 3.3 kV may be adopted by the bidder for the drives in the range of 175-210 kW.

3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.

The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.

Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ Reclaimer shall be 415V AC supply only.

#### 1.14.00 **Tropical Protection**

1.14.01 All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

1.14.02 Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

#### 1.15.00 **Enclosure Protection**

1.15.01 Degree of protection of enclosures as per IS:13947 shall be as follows:

|    | Item                                     | Degree of Protection                 |
|----|------------------------------------------|--------------------------------------|
| 1  | 11kV & 3.3kV Switchgears                 | IP4X                                 |
| 2  | 415V MCC / DBs / Fuse Board              | IP52 for indoor and IP65 for outdoor |
| 3a | Motor                                    | IP55                                 |
| 3b | Motor Actuator                           | IP65                                 |
| 4a | Control and Relay Panel in AC area       | IP3X                                 |
| 4b | Control and Relay Panel in normal area   | IP42                                 |
| 5a | Pushbutton Station/Kiosk/Panel - Indoor  | IP55                                 |
| 5b | -Do - Outdoor                            | IP65                                 |
| 6  | Indoor Junction boxes for cables / wires | IP55                                 |
| 7  | Outdoor lighting fixtures                | IPW55                                |
| 8  | Battery Charger Panel                    | IP42                                 |



- 1.15.02 In fire hazardous areas like gas/ liquid fuel storage/ handling areas, lighting fixtures, switchgears shall be of tested and certified flame proof design.
- 1.16.00 **Painting For Electrical Equipment**  
Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:  
  
Epoxy based with suitable additives. The thickness of finish coat shall be minimum 80 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 80 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.  
  
Paint shade of finish coat shall be as per Section-X of Volume – IIA: Lead Specification.
- 1.17.00 **Redundancy**  
The Contractor shall develop the system configuration based on the concept that failure of any one auxiliary transformer or supply feeder will not affect full load operation or start up/shut down of the unit.
- 1.18.00 **Quality Assurance**
- 1.18.01 The Contractor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.
- 1.18.02 The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.
- 1.18.03 The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.
- 1.18.04 Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.
- 1.18.05 The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.
- 1.18.06 The Owner / Purchaser reserves the right to inspect the Contractor's facilities prior to award of contract.
- 1.18.07 The Owner / Purchaser reserves the right to witness any or all of the tests stipulated in the relevant standards and this specification.
- 1.18.08 The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.



1.19.00 **Drawings / documents for Approval**

1.19.01 The Contractor shall submit his Master Deliverable Schedule considering the priority of the listed documents with respect to the project execution schedule to enable the Owner's Consultants (DCPL) to plan manpower deployment. The documents in the Schedule should be marked in two categories viz. (a) 'For Approval' (A) and (b) 'For Reference' (R).

1.19.02 The Contractor shall assign the basic engineering documents in 'For Approval' category and obtain approval of those documents prior to submittal of corresponding detail engineering documents. For the Bidder's guidance - such documents shall include, but not limited to the following:

- a) Master Deliverable List – Electrical with schedule of submission
- b) Electrical key single line diagram for the entire plant indicating rating of equipment
- c) Electrical system study (load flow, short circuit, motor starting) with software output.
- d) Diagram of Generator, GT, UT & ST with Metering & Protection
- e) Design Memorandum & Sizing Calculation for–
  - i. Generator and Excitation System
  - ii. GCB
  - iii. Generator Busduct
  - iv. GT, UT, ST and other auxiliary transformers
  - v. MV busduct
  - vi. DC System
  - vii. DG Set
  - viii. UPS
  - viii. HT & LT Switchgears
  - ix. HT & LT Cables
- f) General Technical Particulars (GTP) of all electrical equipment
- g) Logic diagram for Generator, GT, UT, ST.- Protection & Annunciation
- h) Logic diagram for HT & LT Switchgears – Incomer, Tie, Bus-coupler, Feeders, Drives
- i) Test protocol for all electrical equipment
- j) Integrated unit protection scheme
- k) Relay setting calculation for Generator, Transformer, 11kV/3.3kV/0.415kV system relay panels
- l) CT and VT calculations for Generator circuit
- m) Electrical single line diagram for auxiliary power distribution system
- n) Design Memorandum - Grounding system
- o) Design Memorandum – Lightning protection system
- p) Design Memorandum – Cable raceway system
- q) Design Memorandum – Station lighting system
- r) Design Memorandum – Chimney & Cooling Tower electrical
- s) Cable numbering scheme
- t) Drive control & measurement philosophy and Plant Control Philosophy
- u) Layout for -
  - i. Transformer Yard
  - ii. 400kV Switchyard
  - iii. HT & LT Switchgear Rooms
  - iv. Electrical Control Rooms
  - v. Battery & Battery Charger Rooms
  - vi. Inter-plant Cable Raceway

- vii. Area Lighting
- viii. Station Grounding Mat
- u) All drawings/data relevant to the equipment like QAP, Guaranteed Technical Particulars, General Arrangement Drawing, Bill of Material, Foundation Plan, Single Line Diagram, Control Schematic, Wiring Diagram, Sizing calculations, etc. shall be furnished for approval of Owner/Owner's Consultant.
- 1.19.03 The Owner's Consultants may review a document assigned in 'For Reference' category as they deem necessary and furnish comments for compliance by the Contractor.
- 2.00.00 **SCOPE OF SUPPLY & WORK**
- 2.01.00 **General**
- 2.01.01 The scope of work related to electrical system is an intrinsic part of the total EPC Contract.  
  
The Bidder's scope shall include design, engineering, manufacture, type testing, inspection & shop testing at supplier's works, packing, forwarding to site including customs clearance/ port clearance (if required), receipt and unloading, in-plant transportation, handling and storage (preservation & conservation of equipment) at site, erection including associated civil and structural works, testing and commissioning of the Electrical equipment/ system and works indicated in subsequent sections of Volumes – V-A, V-B & IIC (Generator) for one (1) unit and balance of plant (BOP) as indicated in this chapter. The scope includes all interface/ interconnections with the electrical systems under this contract as required for main plant, balance of plant, switchyard and other systems mentioned elsewhere. Electrical scope shall be as described briefly in the following clauses but not limited to it.
- 2.01.02 Scope of work shall also cover the design, manufacture, assembly, testing at manufacturer's works/laboratory, supply, delivery, properly packed for transport to site, storing at site of mandatory spares, 3 years O & M spares as detailed hereinafter in subsequent sections of Volumes- V-A, V-B & IIC as required for efficient and trouble free operation.
- 2.02.00 ~~**Generator and Auxiliary System**~~
- 2.02.01 ~~Generator complete in all respects including stator, rotor, bearings, couplings, terminal pads with palms and all its associated supervisory and instrumentation system.~~
- 2.02.02 ~~Complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable including the necessary piping and pipe supports, valves, measuring system along with the control panel and gas cylinders.~~
- 2.02.03 ~~Complete seal oil system including the necessary tanks, pumps, motors, coolers, strainers, piping and pipe supports, valves, measuring system along with control panel.~~
- 2.02.04 ~~Complete water cooling system where applicable including the necessary tanks, pumps, motors, heat exchangers, strainers, piping and pipe supports, valves, measuring system along with control panel.~~
- 2.02.05 ~~Complete excitation system (brushless or static type) with main exciter, excitation transformer, thyristors, pilot exciter, rectifiers and filters, field flashing and field forcing~~

- b) Data Concentrators with redundant Servers (not more than 100 relays shall be connected to one such Data Concentrators); 50 Nos of additional relays (Owner's requirement) shall be considered while designing Data Concentrators
- c) LAN Network along with 61850 Ethernet Switches for both MV & LV Switchgears
- d) HMI station (with Operator Work Station, Engineering Workstations and printers)
- e) Fiber Optical cable & HDPE Conduit (length as required), Terminal equipment such as LIU, etc. (quantity as required), GPS (Two Nos) and Laptops (at least 10 Nos)
- f) Any other equipment required to the intended specification
- g) Suitable gateway to interface DDCMIS and Numerical relay network (at Data concentrator level)

The typical configuration of such a proposed system is enclosed. The numerical relay network shall include relays on all MV & LV switchgears being supplied under this package. Data concentrators shall be distributed functionally and geographically and shall be interconnected through Fibre Optic cables. Required number of FO ports for interface to DDCMIS with Fibre Optic cables shall be made available on all Data concentrators. Provision for connection and arrangement for termination of Fibre Optic cables from DDCMIS at Data concentrator end shall be made.

2.07.00 **DC System**

2.07.01 Lead acid plante type batteries and battery chargers, with the battery taking over and catering to all the loads connected to the D.C. system, including emergency loads for main plant, switchyard and all other areas in the scope of the contractor, as per system requirement.

2.07.02 Following DC systems shall be supplied to cater to various DC loads in the plant:

- a) Two nos. 220V batteries with each battery having Float & Float cum Boost chargers, each rated for 100% capacity for the main plant loads and one 100% capacity Standby Boost charger.
- b) 220V battery with Float & Float cum Boost chargers each rated for 100% capacity to meet CHP requirement.
- c) 220V battery with Float & Float cum Boost chargers each rated for 100% capacity to meet loads of other far-away auxiliary systems like AWRS, make-up water, ash silo (if any) etc.
- d) Two nos. 220V batteries, each battery having Float & Float cum Boost chargers, each rated for 100% capacity for 400kV Switchyard.
- e) Two nos. 24V batteries, each battery having Float & Float cum Boost chargers, each rated for 100% capacity for plant DCS system.

2.07.03 Design / sizing criteria shall be as described in subsequent clauses of this Section.

2.07.04 DC System shall be supplied from a single manufacturer.

2.08.00 **Motors**

Motors along with couplings and coupling guards for all rotating auxiliaries covered under this package.

2.12.02 **LT Power and Control Cables**

LT Power and Control cables as required for the complete plant, building, equipment and switchyard system etc.

2.12.03 **Fire Survival Cables**

Fire Survival Cables, suitable for a minimum temperature of 750 deg. C for 3 hours, for both power & control, shall be provided for the following –

- i. DC emergency lube oil pump
- ii. DC hydrogen seal pump
- iii. Turbine lube oil pump/barring gear
- iv. DC emergency lighting for main building and service building
- v. DC cables for battery to charger & DC distribution boards
- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler Turbine : Generator inter trip which include the interconnection between -
  - Boiler master fuel trip and turbine trip relays
  - Generator trip relays & turbine trip relays
  - Generator trip relays & generator breaker
  - Generator trip relays & field breaker
  - Generator trip relays & unit auxiliary transformer breaker
  - Incomer cables for DG board, emergency board, DC lighting board etc.

2.13.00 **Grounding & Lightning Protection**

2.13.01 Scope of grounding system for the power station complex includes in principle:

- a) System grounding to facilitate ground fault relaying and to reduce the magnitude of transient over voltage
- b) Equipment grounding to provide protection to personnel from potential caused by ground fault currents and lightning discharges.
- c) Electronic Equipment grounding for multiple purpose of signal return, safety, EMI control, and antenna function

2.13.02 System grounding involves grounding of the neutrals of generators, transformers, DG sets etc. as discussed in Clause No. 1.12.00.

2.13.03 Scope also includes stable ground grid for grounding of equipment and structures and for maintaining the step and touch potentials within safe limits. An earth mat buried at a suitable depth of 1.0m below the ground will be laid in and around the power station including transformer yard and switchyard. All metallic parts of equipment, supposed to be kept at earth potential, will be connected to the grounding mat. Buildings, structures, transmission towers, plant railroad tracks, the perimeter fencing will also be connected to the grounding mat. The grounding mat will be interconnected with each other within the plant area. Switchyard earth mat and main plant earth mat shall be connected at minimum two (2) places with test links.

5.06.02 The Numerical Relay Network system be offered from a Integrator /Manufacturer who has designed and successfully done FAT for a network on IEC 61850 with least 100 nos of Communicable Numerical Relays prior to date of Techno-Commercial bid opening.

5.07.00 **HT Motor**

5.07.01 **CW Motor**

The CW pump drive motors should be sourced from a manufacturer who have supplied at least two nos. of 11KV or above, vertical, DOL started squirrel cage induction motors of cooling type specified having rating 2000KW or more and motor speed not exceeding 500 rpm synchronous, which are in successful operation for at least two (2) years as on the date of Techno-Commercial bid opening.

5.07.03 **BFP Motor**

The offered Squirrel cage Induction motor shall be from such a manufacturer who has manufactured and supplied motor of 10MW or above rating, which is in successful operation in at least one (1) plant for a period not less than one (1) year as on the date of Tech no-Commercial bid opening.

5.07.04 **ID Fan Motor**

The offered Squirrel cage Induction motor shall be from such a manufacturer who has manufactured and supplied motor of 4MW or above rating, which is in successful operation in at least one (1) plant for a period not less than one (1) year as on the date of Techno-Commercial bid opening.

5.08.00 **LT Control Cables**

Sub-Vendor should have manufactured and supplied as on date of Techno-Commercial bid opening the following:

- (a) At least 300 km of PVC insulated, PVC sheathed stranded copper conductor 1.1 kV grade cables in one single contract
- (b) At least one (1) km of Flame retardant low smoke cables.

5.09.00 **LT Power Cables**

Sub-Vendor should have manufactured and supplied as on date of Techno-Commercial bid opening the following:

- a) At least 100 km of aluminium conductor, XLPE insulated, PVC sheathed power cables of 1.1 kV or higher grade in one single contract
- b) At least 100 km of aluminium conductor, PVC insulated, PVC sheathed power cables of 1.1 kV or higher grade in one single contract
- c) At least one (1) km of flame retardant low smoke cables.
- d) 1.1kV or higher grade power cable of minimum 630sq.mm. conductor size.

5.10.00 **HT Cables**

Sub-Vendor should have manufactured and supplied following cables, as on date of Techno-Commercial bid opening

- (a) At least 50kms of XLPE insulated power cables of 6.35/11 kV or higher

voltage grade, executed in one or more orders.

- (b) At least one (1) km of flame retardant low smoke cables of any voltage level.

5.11.00 **~~DG Sets~~**

~~Sub-Vendor should have supplied at least two (2) numbers of DG set of rating not less than 1250 kVA, at least one (1) each at two (2) different installations, which should be in successful operation for at least two (2) years as on date of Techno-Commercial bid opening. The make of the DG set (Alternator and Engine) shall be same as that of reference plant DG set.~~

5.12.00 **DC Batteries**

Sub-Vendor should have manufactured and supplied at least two (2) numbers of highest offered rating or above of high discharge type Plante positive plate type battery at least one (1) each at two (2) different industrial installations, which should be in successful operation for at least two (2) years as on date of Techno-Commercial bid opening.

5.13.00 **Battery Charger**

Sub-Vendor should have manufactured and supplied at least two (2) numbers of static automatic voltage regulator type Battery Chargers of highest offered rating or above, at least one (1) each at two (2) different industrial installations, which should be in successful operation for at least two (2) years as on date of Techno-Commercial bid opening.

5.14.00 **Generator Circuit Breaker (GCB)**

~~Sub-Vendor should have designed, manufactured, tested, supplied, erected & commissioned/supervised erection and commissioning of at least two numbers of generator circuit breakers (sulphur hexafluoride) of ratings not below that offered for this project, which are in successful operation for at least two (2) years as on date of Techno-Commercial bid opening. The ratings will constitute of:~~

- ~~a) Rated voltage and current rating.~~
- ~~b) Rated short circuit current carrying capability for one (1) second.~~
- ~~c) Rated short circuit peak making and latching current carrying capability.~~
- ~~d) Rated symmetrical RMS short circuit current interrupting capability.~~

~~The type (sulphur hexafluoride) and rating of breaker offered should also have been successfully type tested as on date of Techno-Commercial bid opening.~~

5.15.00 **400kV Switchyard Equipment (AIS)**

5.15.01 SF6 Circuit Breakers being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of SF6 Circuit Breakers of offered voltage class or higher, and which must have been in successful operation for a minimum period of two (2) years as on date of Techno-Commercial bid opening.

5.15.02 Disconnecting switches being offered should be from manufacturer who has manufactured and supplied minimum thirty (30) nos. of Disconnecting switch of offered voltage class or higher, suitable for air insulated substation/ switchyard and which must have been in successful operation for a minimum period of two (2) years as on date of Techno-Commercial bid opening.

4.02.03      **Battery Racks**

Battery racks for supporting battery cells shall be constructed of best quality FRP forming a rigid structure. Racks shall be painted with at least three (3) coats of electrolyte-resistant paint of approved shade. Batteries shall be preferably be located in single tier arrangement. Racks shall be free standing type, mounted on porcelain / electrolyte-resistant high impact plastic insulators. Numbering tags for each cell shall be attached on to the racks.

4.03.00      **Battery Charger**

4.03.01      **General**

- a)      The charger shall be natural air cooled, solid-state type with full wave, fully controlled, bridge configurations.
- b)      The charger shall be provided with (but not limited to) microprocessor based automatic voltage control, current limiting circuitry, smoothing filter circuit and soft-start feature, under/ over voltage protection and earth fault detection.
- c)      Voltage/current control shall be stepless, smooth and continuous. Voltage control shall be possible either in "Auto" mode or in "Manual" mode. An "Auto-Manual" selector switch shall be provided for this purpose.
- d)      The charger shall be self-protecting against all AC and DC transients and steady state abnormal currents and voltages.
- e)      Charger AC input and DC output shall be electrically isolated from each other and also from panel ground.
- f)      Isolation shall also be provided between power and control circuits.
- g)      Radio frequency suppressor/screening shall be provided with the charger to limit the noise level/interference to radio and other communication equipment to be installed in the same building.
- h)      The design of the equipment will be such that during the period both trickle charger unit and boost charger units are working independently, the tap connection from various taps of the battery cell to the load circuit should not involve any circulating current.

4.03.02      **Construction**

- a)      The charger shall comprise a continuous line up of free-standing, floor mounted sheet steel panels, with access from both from front as well as from rear.
- b)      In between float and float-cum-boost charger panels, a central panel shall be provided. This panel shall house the battery terminals, load terminals, battery blocking diodes, meters, annunciator and indicating lamps.



- c) The panel shall conform to the degree of protection IP 42. Minimum thickness of sheet metal used shall be 2 mm for load bearing members and 1.6 mm for non-load bearing members.
- d) Access doors shall be with concealed hinges and neoprene gaskets. Ventilating louvers shall be covered with fine wire mesh. Door over 600 mm width shall be of double-leaf design.
- e) All equipment within the panels shall be arranged in modular units and laid out with sufficient space for easy maintenance.
- f) All indicating instruments, control switches etc. shall be flush mounted on the front face of the panels. However potentiometer shall be provided inside the panel. Nameplates of approved size and type shall be provided for all circuits and devices both at front & inside of the panel.
- g) All bus bar and bus connections shall be of high conductivity copper and adequately sized to limit the maximum temperature within the permitted value. All bus connection shall be silver plated.
- h) Heat –shrinkable insulating sleeves shall be provided for bus bars. All bus connections shall be color coded for easy identification.
- i) Bus bars shall be supported and braced to withstand the stress due to maximum short circuit current and also to take care of any thermal expansion.

#### **4.03.03 Charger Equipment**

- a) All power diode and control rectifiers shall be silicon type. Rectifier transformer shall be resin impregnated in vacuum, dry type, double wound with copper conductor and class-F insulated with temperature rise limited to class-B having off-circuit tap  $\pm 2.5\%$  on primary side. LC filter suppressor shall be provided in the output to minimize ripple content and to keep the value within the specified limit.
- b) The diode & bridge elements shall be liberally sized for forward current, minimum momentary overloads & voltage spikes. The current & peak inverse voltage (PIV) should be chosen accordingly. Wherever necessary power semiconductor device shall be provided with over current and over temperature protection by using special fuses.  
  
Blocking diodes shall be fully rated and shall have redundancy so that failure of a single diode shall not incapacitate the system in any way.
- c) Isolating switches shall be heavy duty, load break type, operated by an external handle with provision for padlocking in ON & OFF position.
- d) AC Changeover switch shall be 3 position, 4 pole, load break type with 2 NO + 2 NC auxiliary contacts. The switch shall be installed in such a manner that the operating handle shall be accessible only after opening the front door.



- e) Double pole, double throw DC switch shall be load break type with 2 NO + 2 NC auxiliary contacts.
- f) Control switches shall be dust protected, heavy duty, switchboard type complete with escutcheon plates. Contacts shall be silver plated, rated 10A at operating voltage.  
  
Selector switch shall be maintained contact, lockable stay-put type with knob handle. Meter selector switch shall be four-position type.  
  
Ground fault detection switch shall be three-position type spring return to neutral.
- g) Push button shall be heavy duty, shrouded, push to actuate type with colored button and inscription plate. Each push button shall have 2 NO + 2 NC contacts, rated 10A at 240V AC and 5.0A at 220V DC.
- h) Contactor shall be air-break type with hand reset type thermal overload relays having in built temperature compensator and single phase preventor. Contactor duty class shall be AC-3.
- i) Fuses shall be HRC type, mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of base. In such cases, one set of insulated fuse pulling handles shall be supplied with each board. Kick-off fuses (trip fuses) with alarm contacts shall be provided for all DC fuses. Semi conducting device fuses shall be fast-acting. All upstream fuses shall be properly coordinated with corresponding down stream fuses.
- j) Indicating lamps shall be clustered of LEDs suitable for the duty involved. The body shall be made of polycarbonate Unbreakable lens. LEDs shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. Both lamps and lens shall be replaceable from front.
- k) Each battery charger shall be provided with one (1) no. voltage transducer and one (1) no. current transducer for monitoring the DC output. These transducers shall have twin-channel output of 4-20mA and will be used for analog inputs to central DDCMIS/ EDMS.
- l) Ground fault relay shall be provided to detect DC system ground leakage current.
- m) Switch fuse shall be provided to receive incoming AC supply.
- n) Charger shall be equipped with LCD display, so the system or particular module operation parameters can be locally or remotely viewed / monitored. Following parameters to be displayed:
  - Input AC voltage
  - Input AC current
  - Charging voltage

- Charging current
- Load voltage
- Load current
- Battery voltage
- Battery current

#### 4.03.04 Alarms

- a) Solid-state, audio visual annunciation system shall be provided for battery chargers. Annunciation system shall operate on 220V DC.
- b) One (1) minimum twelve-points alarm facia shall be provided on float-cum-boost charger panel, complete with proper actuating devices, circuitry, legends, push buttons (Accept, Reset and Test) and hooter.
- c) Each central panel shall be provided with one (1) minimum eight point alarm facia complete with proper actuating devices, circuitry, legends, push- buttons (Accept, Reset and Test) and hooter.
- d) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button is pressed.
- e) Each time a window lights up, a master relay will get energized to provide group alarm signals for Owner/Purchaser's remote panel.
- f) The requirements of indication/metering/alarms are given in the annexure.
- g) The alarm shall be compatible with central DCS/SCADA

#### 4.03.05 Meters

Meters shall be 96 x 96 mm switchboard type, 90 deg scale, antiglare glass, accuracy class 2.0, with zero adjuster on the front. Charger panel shall be provided with the following meters:

- a) Input voltmeter (0 – 500 V AC) with voltmeter selector switch.
- b) Output DC voltmeter at each charger output.
- c) Output DC voltmeter at battery output.
- d) Output DC ammeter at each charger output (0 – 150% of rated full load charger output)
- e) Battery charging / discharging ammeter.

#### 4.03.06 Transducers

Each battery charger shall be provided with one (1) no. voltage transducer and one (1) no. current transducer for monitoring the DC output. Transducer shall have 4-20mA dual output.

Charger panel shall be provided with the following transducers:

- a) DC voltage transducer at each charger output.
- b) DC current transducer at each charger output.
- c) DC voltage transducer at battery output.

#### 4.03.07 Controls

The following (but not limited to) manual controls shall be provided on the front of each charger panel :

- a) Charger ON/OFF push button.
- b) Selection of float or boost charge in case of float-cum-boost charger.
- c) Voltage setters for setting the output of float/ equalizing / boost charge. Setting shall be independent of each other so that setting of one voltage shall not require resetting other.
- d) Ground fault detection switch with indicating lamps.
- e) Current limit setter/ charging rate.
- f) Under/Over voltage relay including battery earth fault monitoring relay.
- g) Acknowledge-Reset-Test push buttons for annunciation system. The color of reset buttons shall be BLACK.

#### 4.03.08 Lamp/Space heaters/receptacles

- a) The charger panels shall be provided with :-
  - Internal illumination lamp with door switch, the lamp shall be located in the ceiling and guarded with protective cage.
  - Space heater with thermostat control
  - 5 pin 6A receptacle with plug
  - Communication plug.
- b) Lamp, heater and receptacle circuits shall have individual ON-OFF switch fuse units and shall be suitable for 240V AC supply.

#### 4.03.09 Wiring/Cabling

- a) The panels shall be completely wired-up. All wiring shall be routed through wiring troughs.

- b) Wiring shall be done with flexible, 1100V grade, fire resistance PVC insulated switchboard wires with stranded copper conductors of 2.5 mm<sup>2</sup> for control and current circuits and 1.5 mm<sup>2</sup> for voltage circuits.
- c) Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per Bidder's Wiring Diagrams. AC / DC wiring shall have separate color-coding.
- d) Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- e) All spare contacts of relays, timers, auxiliary switches and other devices shall be wired up to the terminal block.
- f) Gland plate shall be of 4 mm thick, non-magnetic material and suitable for single-phase cable entry from bottom. Cable terminal board with cable lugs and double compression cable glands shall be provided in each panel for termination of incoming and outgoing cable.

#### 4.03.10 Terminal Block

- a) 1100V grade, multi way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm<sup>2</sup> stranded copper conductor and provided with acrylic insulating cover.
- b) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Separate terminal blocks shall be used for AC/ DC wiring termination.
- c) Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- d) Terminal blocks used for interface with DDCMIS via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

#### 4.03.11 Grounding

- a) The charger panels shall have fully rated ground bus with two ground terminals, one at each end.
- b) Each terminal shall comprise two-bolt drilling with G.I. bolts, nuts and bimetallic washers for connecting to 50x6 mm G.I. flat. Ground bus shall be bolted to the panel structures, effectively grounding the entire assembly. The cases of meters, relays and switching devices shall be grounded through sheet steel structure.
- c) Wherever, the schematic diagrams indicate a definite ground at the panel, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

#### 4.03.12 Tropical protection

DEVELOPMENT CONSULTANTS

V.V-B/S-III/11

(e-PCT/TS/K/02/2014-15/V-B/SEC-III)

- a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.
- b) Screens of corrosion resistant material shall be furnished on all ventilating louvres to prevent the entrance of insects.

4.03.13 **Painting**

- a) The sheet metal of the panels shall be thoroughly cleaned by chemical agents (7-tank process) as required to produce a smooth clean surface free of scales, grease and rust.
- b) Both interior and exterior surfaces of the panels shall be powder coated and finished with two (2) coats of paints of approved shades. Refer to clause no.1.16.00 of Section -I, Volume V-A.
- c) The paint shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or removed by abrasion due to normal handling.
- d) Sufficient quantity of touch up paint shall be furnished for application after installation at site.

4.03.14 **Nameplate**

- a) Name plate shall be provided for each panel and for each equipment/device mounted on it.
- b) The material shall be anodized aluminum/ lamicoid, 3mm thick, with white letter on black background.
- c) Name plate shall be held by self-tapping screws. The size of name plates shall be approximately 20mm x 75mm for equipment and 40mm x 150mm for panels.
- d) Name plates for panels shall be provided both on the front, rear and also inside the panels.
- e) Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices both inside and outside the panel.
- f) Instrument and devices mounted on the face of the panels shall also be identified on the rear with the instrument / device number. The number may be painted on or adjacent to the instrument or device case.
- g) Caution notice of suitable metal plate shall be affixed at the back of each panel.
- h) Bus bar clamp-on sensor, maximum DC current: 50A

4.04.00 **Battery Discharge Resistor Unit / Portable Single Cell Charger**

**ANNEXURE-B**

**FITTINGS & ACCESSORIES**

**1.0 BATTERY**

|                                                                                      |                                                                                                                                                                      |
|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Each set of battery shall be equipped with fittings and accessories as listed below. |                                                                                                                                                                      |
| 1                                                                                    | One battery log book.                                                                                                                                                |
| 2                                                                                    | Two copies of printed instruction sheet.                                                                                                                             |
| 3                                                                                    | Two nos. cell testing voltmeter (3-0-3 volts) complete with leads.                                                                                                   |
| 4                                                                                    | One no. rubber syringe type hydrometer suitable for specific gravity reading.                                                                                        |
| 5                                                                                    | Three nos. pocket thermometer.(Digital type)                                                                                                                         |
| 6                                                                                    | Two nos. thermometer (0 to 100°) with specific gravity correction scale.                                                                                             |
| 7                                                                                    | One set cell bridging connector.                                                                                                                                     |
| 8                                                                                    | Two nos. each Electrolyte resistant plastic funnels and plastic jugs                                                                                                 |
| 9                                                                                    | Battery racks suitable for accommodating the cells coated with paint.                                                                                                |
| 10                                                                                   | Insulator (with 5% extra), rubber pad etc. for rack.                                                                                                                 |
| 11                                                                                   | Two nos. plastic filling bottle for filling up.                                                                                                                      |
| 12                                                                                   | One pair of spanners.                                                                                                                                                |
| 13                                                                                   | Requisite quantity of electrolyte with 10% extra in non-returnable containers.                                                                                       |
| 14                                                                                   | Two pairs of rubber hand gloves.                                                                                                                                     |
| 15                                                                                   | Two nos. cell lifting straps.                                                                                                                                        |
| 16                                                                                   | One set of inter cell, inter tie and inter bank connectors as required for complete installation.                                                                    |
| 17                                                                                   | Self adhesive PVC stickers for cell numberings                                                                                                                       |
| 18                                                                                   | Goggles.                                                                                                                                                             |
| <b>NOTE:</b>                                                                         | Any other accessories if required for satisfactory operation of the complete battery system shall also be included in Bidder's offer and to be supplied accordingly. |

## ANNEXURE-C

### LIST OF ALARMS & AND INDICATIONS

- 1.0 Following list of alarm / annunciation shall be provided at each charger.
  - a) AC supply failure.
  - b) Charger overload.
  - c) SCR fuse blown.
  - d) Filter fuse blown.
  - e) DC output fuse blown.
  - f) DC system under voltage.
  - g) DC system over voltage.
  - h) Battery earth fault.
  - i) AC Input fuse blown
- 2.0 Initiating contacts wired to two terminals at battery charger panel shall be provided for group annunciation "Battery Charger Trouble" of the events mentioned above, at central control room. Separate contacts shall be provided for "Battery earth fault" annunciation at central back-up panel.
- 3.0 Initiating contacts for all alarm points shall also have electrically separate spare set of contacts wired to the terminal block for future use.
- 4.0 All alarm contacts shall be rated 5.0A at 220V DC and 10 Amp. at 240V AC.
- 5.0 In addition to the alarm points mentioned above, any other alarm point, if required for battery charger, shall be provided.
- 6.0 Charger panel shall also have the following minimum indications:
  - a) Charger power supply ON (at all three phases)
  - b) Charger DC output healthy.
  - c) Control supply ON.
  - d) DC supply healthy.
  - e) Float / boost charger in operation (in float-cum-boost charger)

**VOLUME: VI**  
**SECTION-VII**  
**TECHNICAL SPECIFICATION –**  
**FIELD INSTRUMENTS & FLOW ELEMENTS ,**  
**CONTROL VALVES , I&C CABLES , ERECTION**  
**HARDWARES , TOOLS & TACKLE**



## **CONTENT**

| <b><u>SECTION /SUBSECTION</u></b> | <b><u>DESCRIPTION</u></b>                    |
|-----------------------------------|----------------------------------------------|
| VII/A                             | FIELD INSTRUMENTS & FLOW ELEMENTS            |
| VII/B                             | CONTROL VALVES                               |
| VII/C                             | INSTRUMENTATION AND CONTROL CABLES           |
| VII/D                             | PANELS , DESKS , RACKS AND JUNCTION<br>BOXES |
| VII/E                             | ERECTION HARDWARES                           |
| VI/F                              | TOOLS AND TACKLE                             |

**VOLUME : VI**  
**SECTION-VII**  
**SUB SECTION - A**  
**FIELD INSTRUMENTS & FLOW ELEMENTS**

**1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

**1.01.00 PRESSURE TRANSMITTER**

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

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

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

#### 1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

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

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

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

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

1.03.00 Displacer Type Level Transmitters

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

|     |                                     |                                                                                                                                                                                                                                                                              |
|-----|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | pressure                            | permanent deformation or loss of accuracy                                                                                                                                                                                                                                    |
| 14. | Turn-down ratio                     | : 10 : 1 or better                                                                                                                                                                                                                                                           |
| 15. | Zero & Span                         | : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span                                                                                                                                                            |
| 16. | Enclosure Class                     | : IP-65                                                                                                                                                                                                                                                                      |
| 17. | Output Indicator                    | : LCD type (Integral indicator of 5 digit display)                                                                                                                                                                                                                           |
| 18. | Nameplate                           | : Tag number and Service engraved in stainless steel tag plate                                                                                                                                                                                                               |
| 19. | Ambient Temperature                 | : 0 - 50 °C                                                                                                                                                                                                                                                                  |
| 20. | Load Impedance                      | : 600 Ohms at 24 Volts (minimum)                                                                                                                                                                                                                                             |
| 21. | Process Connection                  | : 2" Flanged                                                                                                                                                                                                                                                                 |
| 22. | Performance - Accuracy              | : $\pm 0.075$ % of span or better                                                                                                                                                                                                                                            |
| 23. | Accessories                         | : <ul style="list-style-type: none"> <li>a) Counter Flange, nuts, bolts, gaskets etc</li> <li>b) Weights for 5 point calibration of instruments</li> <li>c) Vent and drain plugs</li> <li>d) <math>\frac{1}{2}</math>" NPT Glands</li> <li>e) Handheld calibrator</li> </ul> |
| 24. | Preferred Features                  | : <ul style="list-style-type: none"> <li>a) Test plug connection and cutout terminals physically separated from other electronics</li> <li>b) Electronic Damping facility (adjustable)</li> </ul>                                                                            |
| 25. | Adjustment/Calibration/ Maintenance | : From handheld calibrator/ HART management system                                                                                                                                                                                                                           |

---

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



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

**1.05.00 RADAR TYPE LEVEL MEASUREMENT**

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

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

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

1.07.00 ULTRASONIC FLOW TRANSMITTER

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

*Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.*

2.00.00 **HART HAND HELD CALIBRATOR**

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

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

### 3.00.00 PROCESS ACTUATED SWITCHES

#### 3.01.00 PRESSURE SWITCH

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

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

### 3.02.00 DIFFERENTIAL PRESSURE SWITCH

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

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

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

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



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

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

3.04.00 FLOW SWITCH

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

3.05.00 RF LEVEL SWITCH

- 
- |                             |   |                                                   |
|-----------------------------|---|---------------------------------------------------|
| 1. Type                     | : | RADIO FREQUENCY                                   |
| Sensing probe               |   |                                                   |
| 2. Material                 | : | SS-316                                            |
| 3. Mounting                 | : | Threaded                                          |
| Application                 |   |                                                   |
| 4. Temperature              | : | 250°C (Max.)                                      |
| Electronic Controller       |   |                                                   |
| 5. Input Supply Voltage     | : | 240V AC ±10%, 50 Hz.                              |
| 6. Relay Output             | : | 2 SPDT (240V AC, 5A)                              |
| 7. Ambient Temperature      | : | 50 °C                                             |
| 8. Enclosure Protection     | : | IP-66                                             |
| 9. Enclosure Housing        | : | SS                                                |
|                             |   | Normal Level                                      |
|                             |   | Power On                                          |
| 10. Local LED Indication    | : | Alarm Level                                       |
|                             |   | Probe Healthy                                     |
| 11. Switching Repeatability | : | ±0.5%                                             |
|                             |   | Co-axial cable for probe connection to controller |
| 12. Accessories             | : | SS Tag plate                                      |
|                             |   | ½" NPT Cable Glands                               |
| 13. Application             | : | Solid level                                       |

**3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH**

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

---

|                          |   |                                                                                                                                                                      |
|--------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6. Input Supply Voltage  | : | 240V AC $\pm$ 10%, 50 Hz.<br>Four independent channel with                                                                                                           |
| 7. Input                 | : | selectable switching threshold for water conductivity                                                                                                                |
| 8. Relay Output          | : | 2 SPDT (240V AC, 5A)                                                                                                                                                 |
| 9. Ambient Temperature   | : | 50 °C                                                                                                                                                                |
| 10. Enclosure Protection | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area)                                                                                                             |
| 11. Enclosure Housing    | : | SS<br>HI,LO, HIGH-HIGH, LOW-LOW                                                                                                                                      |
| 12. Local LED Indication | : | Power<br>Fault                                                                                                                                                       |
| 13. Accessories          | : | a) Interconnecting cable from probe to electronics<br>b) Mounting accessories<br>c) External cage<br>d) Washer & Gasket<br>e) ½" NPT Cable Glands<br>f) SS Tag Plate |
| 14. Application          | : | During Detail Engineering on Owner's approval                                                                                                                        |

**3.07.00 TEMPERATURE SWITCH**

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

- 
- |     |                       |   |                                                                                                                                                      |
|-----|-----------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.  | Movement Material     | : | Stainless Steel                                                                                                                                      |
| 6.  | Case material         | : | Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 7.. | Scale                 | : | Black graduation on white linear scale. Graduation 0-100% with red pointer for set points                                                            |
| 8.  | Over range Protection | : | 120 %                                                                                                                                                |
| 9.  | Instrument connection | : | Bottom                                                                                                                                               |
| 10. | Switch configuration  | : | Two SPDT (240V, 5A AC/220V, 0.5A DC)                                                                                                                 |
| 11. | Switch type           | : | Snap acting, shock and vibration-proof                                                                                                               |
| 12. | Adjustability         | : | Internal Set point adjustable over span range                                                                                                        |
| 13. | Compensation          | : | a) Capillary compensation with invar wire throughout the capillary length<br>b) Case compensation                                                    |
| 14. | Performance           |   |                                                                                                                                                      |
|     | a) Scale Accuracy     | : | $\pm 1.0$ % of full scale                                                                                                                            |
|     | b) Repeatability      | : | < 0.5 % of full range                                                                                                                                |
|     | c) Response time      | : | Less than 40 seconds with thermowell                                                                                                                 |
| 15. | Capillary length      | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting                                                                             |
| 16. | Nameplate             | : | Tag number, service engraved in stainless steel tag plate                                                                                            |
| 17. | Accessories           | : | Mounting accessories, ½" NPT cable gland                                                                                                             |
| 18. | Applications          | : | During Detail Engineering on Owner's                                                                                                                 |

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

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

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

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

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

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



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

**5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES**

**5.01.00 RESISTANCE TEMPERATURE DETECTOR**

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

- 
- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.
- Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
- Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
10. Accessories : a)
- b) Compression fittings/unions
- Flanges etc. (for flanged connections only)
- c)
- Thermowell (As specified below)
- d)
11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- Tag number, service engraved in
12. Nameplate : stainless steel tag plate

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

5.02.00 THERMOCOUPLES

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

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

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

5.03.00 TEMPERATURE GAUGE

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

|         |                       |                                                                            |
|---------|-----------------------|----------------------------------------------------------------------------|
|         |                       | cover conforming to IP 65.                                                 |
| 7.      | Dial size             | : 150 mm                                                                   |
| 8.      | Scale                 | : Black lettering on white background in 270 Deg.C arc                     |
| 9.      | Over range protection | : 125 percent of FSD                                                       |
| 10.     | Capillary Glanding    | : 1/2" NPT(M) x compression fitting (SS) to suit capillary                 |
| 11.     | Instrument Connection | : Bottom connection for local mounting, back connection for panel mounting |
| 12.     | Process Connection    | : 1/2" NPT (M) or 150 RF Flanged                                           |
| 13.     | Extension Neck Length | : 50 mm                                                                    |
| 14.     | Compensation          | : a) Capillary compensation                                                |
| 15.     |                       | : b) Case compensation                                                     |
| 16.     | Performance           | : a) Accuracy : + /- 1.0 percent of full scale Deflection                  |
|         |                       | : b) Repeatability : Less than 0.5 percent of full range                   |
|         |                       | : c) Response time: 15 seconds (max.).                                     |
| 17.     | Capillary length      | : 3.0 meters (local) / 15.0 metres (local panel)                           |
| 18.     | Other features        | : Shatter proof glass                                                      |
| 19.     | Nameplate             | : Tag number, service engraved in stainless steel tag plate                |
| 20.     | Accessories           | : SS316 Thermowell                                                         |
| 5.04.00 | THERMOWELL            |                                                                            |
| 1.      | Material              | : SS-316                                                                   |
| 2.      | Manufacture           | : Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)  |

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

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

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

#### 5.05.00 METAL TEMPERATURE THERMOCOUPLE

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

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

*Notes:*

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

6.00.00      **FLOW ELEMENTS**

6.01.00      ORIFICE PLATE

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

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

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

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

ORIFICE FLANGE

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

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

6.01.07      Gasket shall be CAF type depend on application.

CARRIER RING

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

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



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

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

**VOLUME : VI**  
**SECTION-VII**  
**SUB SECTION - C**  
**INSTRUMENTATION AND CONTROL CABLES**

**1.00.00 GENERAL TECHNICAL REQUIREMENTS**

- 1.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety. Repaired cables are not acceptable.
- 1.02.00 FRLS marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Durable marking at intervals not exceeding 625mm shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / type of compensating /extension cable), Insulation material, FRLS etc.
- 1.03.00 Progressive sequential length marking shall also be provided at every meter interval on outer sheath of cable.
- 1.04.00 Non returnable standard seasoned wooden drum containing minimum 500 /1000 M  $\pm$  5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.
- 1.05.00 Thermocouple Extension & Compensating Cable
- |     |                         |   |                                                                                                                                                                                                                                                                                                                                                                                    |
|-----|-------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01. | Conductor               | : | Solid conductor                                                                                                                                                                                                                                                                                                                                                                    |
| 02. | Conductor size          | : | 16 AWG (1.31 Sq. mm)                                                                                                                                                                                                                                                                                                                                                               |
| 03. | Type                    | : | KX (Compensating) (Chromel Alumel)<br>RX (Compensating) (Copper-Copper alloy) JX (Compensating) (Iron Constantan)                                                                                                                                                                                                                                                                  |
| 04. | Conductor Insulation    | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick                                                                                                                                                                                                                                                                                                                                          |
| 05. | Operating Voltage       | : | 650V                                                                                                                                                                                                                                                                                                                                                                               |
| 06. | Twisting                | : | Pair twisted with lay of 60 mm (max)                                                                                                                                                                                                                                                                                                                                               |
| 07. | Twisting Direction      | : | All pairs in the same direction. Lapped to form bunch with mylar tape.                                                                                                                                                                                                                                                                                                             |
| 08. | Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 $\mu$ m (min.) for individual pair screen and 60 $\mu$ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |
| 09. | Drain wire              | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) (For both individual and overall screen)                                                                                                                                                                                                                                               |
| 10. | Inner Sheath            | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)                                                                                                                                                                                                                                                                                                      |

- HR PVC Type ST2 of IS-5831,1984  
 Thickness as per IS-1554Part-I 1976
11. Rip Cord : Non metallic under sheath
12. Armouring : GI wire / strip as per IS 3975
13. Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)  
 HR PVC Type ST2 of IS-5831,1984  
 Thickness 1.8 mm (Min)
14. Filler : Non hygroscopic with FRLS property
15. Temperature Range : Up to 85 °C
16. Insulation at 20<sup>0</sup> C : 100 MOhms/Km [Min]
17. Capacitance at 800 Hz : 200 nf/km
18. Cross talk : 60 dB
19. Attenuation : 1.2 dB/Km
20. Codes & Standards : a) IEC 332-1  
 b) ANSI MC 96.1  
 c) IS-8784-1987
21. Tests : a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)  
 a) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I  
 b) Temp Index : Min 250 DEG C at 21Oxy. Ind. (ASTM-D-2863)  
 c) Smoke Density Rating : Max.60% (ASTM-D-2843).  
 d) Flammability Test : as per IEC 332 Part-I /IEEE-383  
 Swedish Chimney Test - SS-424-1475 F3  
 e) High voltage test  
 Core to core- 2.0 KV for 1 min.  
 Core to screen- 2.0 KV for 1 min.  
 f) Insulation Resistance 100 M Ohm / Km Min  
 g) Rodent & Termite repulsion test (Presence of lead shall be confirmed)
22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

| CABLE TYPE | OVERALL SHEATH COLOR | WIRE     | SHEATH COLOR | CONDUCTOR MATERIAL  |
|------------|----------------------|----------|--------------|---------------------|
| KX         | Yellow               | Positive | Yellow       | Nickel / Chromium   |
|            |                      | Negative | Red          | Nickel / Aluminum   |
| JX         | Black                | Positive | White        | Iron                |
|            |                      | Negative | Red          | Constantan          |
| RX         | Green                | Positive | Black        | Copper              |
|            |                      | Negative | Red          | Copper Nickel Alloy |

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs. Each core printed with number or numbered binder tape shall be provided on each pair.

1.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
02. Conductor size : 0.5
03. Conductor resistance : 39  $\Omega$
04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05. Operating Voltage : 650V
06. Twisting : Twin twisted with lay of 60 mm
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28  $\mu\text{m}$  (min.) for individual pair screen and 60  $\mu\text{m}$  (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
  - \* Analog signals- Individual pair & overall shield to be considered.
  - \* Binary signals- overall shield to be considered.
09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)

- |                            |   |                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10. Inner Sheath           | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)<br>HR PVC Type ST2 of IS-5831,1984<br>Thickness as per IS-1554, Part-I 1976                                                                                                                                                                                                                                         |
| 11. Rip Cord               | : | Non metallic under sheath                                                                                                                                                                                                                                                                                                                                                                         |
| 12. Armouring              | : | GI wire / strip as per IS 3975                                                                                                                                                                                                                                                                                                                                                                    |
| 13. Outer Sheath           | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)<br>HR PVC Type ST2 of IS-5831,1984<br>Thickness 1.8mm (Min)                                                                                                                                                                                                                                                         |
| 14. Filler                 | : | Non hygroscopic with FRLS property.                                                                                                                                                                                                                                                                                                                                                               |
| 15. Temperature Range      | : | 85 °C                                                                                                                                                                                                                                                                                                                                                                                             |
| 16. Insulation at 20 Deg.C | : | 100 MOhms/Km [Min]                                                                                                                                                                                                                                                                                                                                                                                |
| 17. Capacitance at 800 Hz  | : | 120 nf/km                                                                                                                                                                                                                                                                                                                                                                                         |
| 18. Cross talk             | : | 60 dB                                                                                                                                                                                                                                                                                                                                                                                             |
| 19. Attenuation            | : | 1.2 dB/Km                                                                                                                                                                                                                                                                                                                                                                                         |
| 20. Codes & Standards      | : | a) IPCEA-S-61-402<br>b) BS 5308<br>c) IEC 332-1<br>d) ASTM-B-33<br>e) IS-8130-1984<br>f) IS 1554 Part-1<br>g) IS 10810                                                                                                                                                                                                                                                                            |
| 21. Sheath colour          | : | Inner- Black and Outer- Gray                                                                                                                                                                                                                                                                                                                                                                      |
| 22. Tests                  | : | a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)<br>b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I<br>c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)<br>d) Smoke Density Rating : Max.60% (ASTM-D-2843).<br>e) Flammability Test : as per IEC 332 Part-I<br>f) Swedish Chimney Test-SS-424-1475 F3<br>g) Insulation Resistance 100 M Ohm / Km Min<br>h) High voltage test |

Core to core- 2.0 KV for 1 min.  
 Core to screen- 2.0 KV for 1 min.

- i) Rodent & Termite repulsion test  
 (Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

| PAIR | CORE | COLOR  |
|------|------|--------|
| 1st  | 1st  | Blue   |
| 1st  | 2nd  | Red    |
| 2nd  | 1st  | Gray   |
| 2nd  | 2nd  | Yellow |
| 3rd  | 1st  | Green  |
| 3rd  | 2nd  | Brown  |
| 4th  | 1st  | White  |
| 4th  | 2nd  | Black  |

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1<sup>st</sup>. unit, double band for 2<sup>nd</sup>. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

1.07.00 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, and twisted & shielded.

1.08.00 Control & power Cable

Bidder shall refer to Volume IIF of the electrical specification for detail.

1.09.00 Optical Fiber Cable

Bidder shall supply and install optical fiber cable and all cable accessories and fittings like Light Interface Unit, Surge suppressors, Opto isolators, Interface converters, Fiber Optic Card Cage, Fiber Optic Line Driver, Repeater/ Modem, cable glands, grommets, lugs, termination kits etc on as required basis.

Optical Fiber Cable shall be 4/8/12 core. Each core shall be of ultra pure fused silica glass with UV cure acrylate suitable to withstand temperature between 20 and 80°C. The cable shall have multiple mono mode fiber. On as required basis so as to avoid usage of any repeaters. . Fiber optic cable shall be of loose buffer tube design with 4 fibers per buffer tube ( minimum). Interstices and buffer tubes shall be filled with water blocking compound such as thixotropic gelly to protect against moisture and vibration. Buffer tube shall



be made of materials like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification.. Buffer tubes shall be stranded around Central Strength Member utilizing Reverse Oscillating Lay ( ROL). Blank fillers shall be used as necessary to maintain circular cable structure.

The central strength member shall be Fiber Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti-buckling strength to cable.

The interstices between buffer tube and jacket layers shall be protected from water intrusion by a combination of dry water blocking yarns and tapes. These dry materials shall be easily removable from core during cable preparation without use of cleaning solvent.

In addition to central strength member, additional strengthening substance like aramid yarns shall be applied helically over the cable core to provide additional tensile strength to cable.

The cable shall be of dual jacket and armoured. Inner sheath consists of medium density poly ethylene extruded over cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. Electrolytically chrome plated corrugated steel taped (ECCST) armouring is provided around inner jacket to provide additional cable compression strength and rodent protection. The armour is covered with outer black MDPE sheath with FRLS and UV resistance properties. A ripcord is also placed under neath the armour for easy outer sheathing removal. The cable shall be suitable for a maximum tensile force of 2000N during installation and once installed, a tensile force of 1000N minimum. The compressive strength of cable shall be 3000N minimum and crush resistance 4000N minimum. Minimum bending radius shall be equal to or more than 15D.

Specification for G.652 Monomode Fiber:

| Sl. No. | Attribute                                                                       | Value                           |
|---------|---------------------------------------------------------------------------------|---------------------------------|
| 1       | Core Diameter                                                                   | 9±1 micrometer                  |
| 2       | Cladding Diameter                                                               | 125±1 micrometer                |
| 3       | Cladding non circularity                                                        | ≤1.0%                           |
| 4       | Attenuation coefficient at<br>(i) 1290 nm to 1340 nm<br>(ii) 1525 nm to 1575 nm | <0.36 Db/km<br><0.25 Db/km      |
| 5       | Chromatic dispersion coefficient at<br>(i) 1310 nm<br>(ii) 1550 nm              | <3.5 ps/ nm.km<br><18 ps/ nm.km |
| 6       | Polarization Mode Dispersion (PMD)                                              | ≤0.5 ps/√km                     |

|    |                                                       |                                            |
|----|-------------------------------------------------------|--------------------------------------------|
|    | coefficient                                           |                                            |
| 7  | Mode field diameter at<br>(i) 1310 nm<br>(ii) 1550 nm | 9.2±0.4 micrometer<br>10.50±1.0 micrometer |
| 8  | Mode field concentricity error                        | ≤0.5 micrometer                            |
| 9  | Proof test                                            | ≥1%                                        |
| 10 | Fiber Curl                                            | ≥ 4.0 m                                    |
| 11 | Macro bend test on fiber at 1550 nm                   | ≤0.1 dB                                    |

The entire length of the cable shall be marked with the manufacturer name, month and year of manufacture, coded description of the cable based on Telcordia's(Bellcore) SR-2014 Suggested Optical Cable Code (SOCC), progressive sequential length marking at every meter interval on outer sheath.

Following tests as per any approved standards such as FOTP, IEC etc shall be carried out on the cables:

- a. Attenuation and dispersion characteristics test
- b. Proof test
- c. Macro-Bend Resistance Test
- d. Mechanical Tests
- e. Low and High Temperature Cable Bend Test
- f. Impact Resistance Test
- g. Compressive Strength Test
- h. Tensile Strength Test
- i. Cable Twist Test
- j. Cable Cyclic Flexing Test
- k. Environmental Characteristics Test
- l. Temperature Cycling Test
- m. Color Performance Test
- n. Cable Aging Test
- o. Water Penetration Test
- p. Lightning Test
- q. Routine Test/ Sample Test
- r. Site Test ( Continuity and Attenuation)

s. FRLS Test

1.10.00 Coaxial Cable

|    |                       |                                                    |
|----|-----------------------|----------------------------------------------------|
|    |                       |                                                    |
| 1  | Standard              | : MIL-17G, IS-5026                                 |
| 2  | Inner conductor       | : Tinned copper ( Cu Sn)                           |
| 3  | Size                  | : 0.94 mm dia ( 19 stranded)                       |
| 4  | Dielectric insulation | : Cellular foam polyethelyne                       |
| 5  | Overall diameter      | : 2.95 mm                                          |
| 6  | Shielding             | : Aluminium mylar tape                             |
| 7  | Outer conductor       | : Cu Sn- Braid, 96% lapping ( Overall dia 3.60 mm) |
| 8  | Armoring              | : Galvanized mild steel                            |
| 9  | Outer sheath          | : FRLS PVC                                         |
| 10 | Temperature range     | : 85°C                                             |
| 11 | Attenuation           | : Up to max 39.5 Db/100 m                          |

**VOLUME : VI**  
**SECTION-VII**  
**SUB SECTION - D**  
**PANELS , DESKS , RACKS AND JUNCTION BOXES**

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

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

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

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



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

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

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

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

be mounted on the back up panels.

**2.04.00 PANELS/CABINETS**

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

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

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

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

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

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

**2.04.07 TECHNICAL PARTICULARS**

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

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

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures

12. Name Plate : Both at front and back surface of the panel

13. Fixing of name plate : Stainless steel pan head screws

14. Name plate material : Laminated phenolic (3 layers)

15. Lettering : Black with white engraved

16. Mounting of terminal blocks : Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

## 2.05.00 FURNITURE

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

### 2.05.01 WORK STATION FURNITURE

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

### 2.05.02 PC RACK

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

### 2.05.03 CHAIRS

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

**2.05.04 TABLES**

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

**2.05.05 ALMIRAHs**

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

**2.05.06 KEYPAD**

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

**2.05.07 LOCKERS**

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

**3.00.00 LVS PANEL**

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

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

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

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

- member, which would reduce access, shall be avoided.
- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and 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.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with 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.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or



falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

4.03.06 Power supplies for miscellaneous devices shall be provided with 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.

4.04.00 JUNCTION BOX

- |                      |   |                                                                                          |
|----------------------|---|------------------------------------------------------------------------------------------|
| 1. Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65                                            |
| 2. Material          | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)                        |
| 3. Type of Cover     | : | Solid unhinged with retention chain / Screwed at all four corners                        |
| 4. Paint             | : | i) Exterior : Opaline green shade 275 of IS: 5<br>ii) Interior - Brilliant Glossy White. |

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head  
External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.

**VOLUME : VI**  
**SECTION-VI**  
**SUB SECTION - B**  
**PROGRAMMABLE LOGIC CONTROLLER (PLC) /**  
**PROPRIETARY CONTROL SYSTEM**

**1.00.00 GENERAL**

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

- 1.06.01 The redundant upper level network of each Package PLC system will be connected to redundant server to be located in Plant Engineer's room. Suitable Fibre optic cable shall be used for redundant interconnections.
- 1.06.02 The hot redundant Server shall continuously update all the inputs. The switchover to the hot standby Server shall be smooth and bump less with proper indication to the operator.
- 1.06.03 In addition to local PLC Workstations , programming activities for control systems of all the packages including set point change , logic build up & modifications , graphics build up & modifications etc . shall also be achieved through Common DDCMIS network workstation.
- 1.06.04 Common DDCMIS Network workstations stations, local workstations shall have access to the processor of the individual package control system for programming. Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification.
- 1.06.05 All the screens as available in the local package monitors will be also available one to one basis in the Common DDCMIS network screens. Alarm monitoring / reporting, generation of logs, trends, calculations, printing of logs & reports etc. shall be available in local workstations as well as in remote Common DDCMIS network workstations .In case of failure of Common DDCMIS network, control and monitoring of the individual packages shall still be possible from the Operator Work Stations in the respective package control room
- 1.06.06 There shall be flexibility in operation from CCR Common DDCMIS network operator workstations. Any of the BOP packages can be controlled and monitored from any of the workstations. .
- 1.06.07 The system shall permit carrying out of the on-line dynamic test and self-diagnostic checks while maintaining safe condition and without endangering the safety of equipment without having any influence on the process being controlled.

**2.00.00 GENERAL TECHNICAL REQUIREMENTS**

- 2.01.00 Bidders scope of supply shall include , but not limited to , Hot standby local PLC / Proprietary control & monitoring system for each of BOP areas and shall consist of IO cards, remote and Local IO rack, control rack, redundant Power supply modules, redundant communication /networking and interconnection Cables, redundant processor and communication cards, redundant Servers, operator work stations / GUI , LVS , printer, redundant networking hardware, redundant interface hardwares / softwares with DDCMIS , MCS , PADO etc. , system cabinets ,startup, commissioning, mandatory and recommended spares, drawing, documents and training to owner's personnels at site and at vendors works etc.
- 2.02.00 All types of programming packages shall be licensed with facility of editing and configuration. For each of the PLC / proprietary control system, the programming software shall be supplied in a laptop for each package

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

- 2.03.00 In addition to the Operator and/ cum Engineering workstations , Bidder shall also supply LCD screen based display unit, control switches and other operational keys (GUI). Bidder shall also provide minimum of one no. laptop computer for each PLC based package and with latest hardware configuration and loaded with suitable operating , application program including licensed softwares as a backup engineering cum programming and configuration station. This loaded laptop shall be handed over by Bidder well in advance of FAT to Owner's head office at Hyderabad .
- 2.04.00 The System shall allow dependable and effective control of the process equipment and shall be designed for maximum integrity and reliability. Integrity shall be maintained by providing a dual hot redundant system .The System shall have a capability to monitor and take actions for distributed functions from a central location.
- 2.05.00 The control & Instrumentation shall be through dedicated microprocessor based PLC ,Common DDCMIS network ,proprietary system for the each of the respective plants covering the total functional requirement of sequence control, regulatory control, interlock & protection, monitoring, alarm, data logging.
- 2.06.00 The loop cycle time shall be less than 1 sec for close loops and open loops. The switchover from main controller to redundant controller shall be bumpless; and shall be within one cycle time i.e. within 50 msec.
- 2.07.00 Each controller shall have 40% functional capacity to implement additional functional blocks over and above implemented logic / loops under worst loading conditions.
- 2.08.00 Field Input/Outputs
- The System shall meet the following I/O card requirements.  
The maximum number of inputs / outputs to be connected to each type of module shall be as follows:
- |     |                      |    |
|-----|----------------------|----|
| a)  | Analog input module  | 8  |
| b). | Analog output module | 8  |
| c)  | Binary input module  | 16 |
| d)  | Binary output module | 16 |
- 2.09.00 Communications System
- 2.09.01 The Bidder shall include a dual hot redundant communication system
- 2.09.02 The data highway speed shall be 1000 Mbps.
- 2.10.00 Operator Interface
- Operator Work Station (OWS) / GUI / LVS shall perform control monitoring and operation of all auxiliaries/ drives . However , Push button stations are

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

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

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



6.00.00      **INSPECTION AND TESTING**

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

a)      Identification and Testing

i)      All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards and test certificates shall be made available to the Owner.

ii)      Tests for each pump included under this section shall include but not be limited to the following :

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.
- Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.
- Wearing rings shall be subjected to Dye Penetration Test.
- Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.
- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.
- Complete Inspection of assembled pump.

b)      Hydrostatic Testing

The pump casing shall be hydrostatically tested at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the above values maximum suction pressure shall be taken into account.

c)      Performance Test at Shop

- i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in 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 and power shall be as 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 up to pump shut-off condition. A minimum of five combinations of head and 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) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump Annexures.
- v) 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.

**7.00.00 DRAWINGS, DATA, CURVES AND INFORMATION**

**7.01.00** The Bidder shall submit the following along with his formal proposal besides the different information plate required as indicated elsewhere in this section.

**7.01.01 Drawings**

- a) General arrangement drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall be included.
- b) Typical cross-section drawing showing various components of the pumps offered materials of construction etc.

**7.01.02 Data and Curves**

- a) Determination of pump total dynamic head and rated capacity as per guidelines specified in Section-I of this Volume. Detailed calculations shall be shown by the Bidder.
- b) Anticipated performance curves showing the following characteristics :
  - i) Capacity vs. head

- ii) Capacity vs. power
    - iii) Capacity vs. efficiency
    - iv) Capacity vs. NPSH required
    - v) System resistance curves
  - c) Speed vs. torque curve of the pump corresponding to recommended mode of pump starting superimposed on speed vs. torque curves of the drive unit corresponding to 80%, 90%, 100% of the rated voltage (applicable only in the cases of pumps with drive motor power rating of 100 KW and above).
  - d) Completely filled-in Technical particulars enclosed under Volume-IX of this specification.
- 7.02.00 The successful Bidder shall furnish the following drawings/data for Purchaser/Engineer's approval after award of the contract.
- 7.02.01 Final versions of all the drawings, documents as specified in clause no. 7.01.00 above.
- 7.02.02 Pump foundation details along with all design loads, direction and points of application.
- 7.02.03 Test reports, test certificates and other particulars.
- 7.02.04 All other applicable drawings and documents as specified in Volume-IIA of this specification.

- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
  - i) When some important repair work is involved to make the job acceptable.
  - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

**4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES**

**4.01.00** The Owner's Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Owner's Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

**4.02.00** The Contractor shall give the Owner's Engineer/ Authorized Inspector twenty one (21) days written notice for "CHP" / "W" points of any material being ready for testing by owner' engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner's Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-6         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                                                |                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| <p style="text-align: center;"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1>Annexure-6</h1> <h2>Void</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-7         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                                                |                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <p style="text-align: center;"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1>Annexure-7</h1> <h2>QAP Guide Line &amp; Formats</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|

|                                                   |                      |                     |                      |               |
|---------------------------------------------------|----------------------|---------------------|----------------------|---------------|
| <b>Revisions:</b><br>Refer to record of revisions | <b>Prepared by :</b> | <b>Checked by :</b> | <b>Approved by :</b> | <b>Date :</b> |
|                                                   | RATISH KUMAR         | GIRISH PALO         | SURYA SATYA NAGESH M | 10.03.20      |

|                                                                                                                                                                                                                                                       |                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| TD-201<br>Rev No. 00                                                                                                                                                                                                                                  | Form No.<br><br> | <div> <div>PRODUCT STANDARD</div> <div>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</div> <div>HYDERABAD</div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ANNEXURE -<br>Rev No. 00<br>Page 1 of 3 |
| <div> <div>COPYRIGHT AND CONFIDENTIAL</div> <div>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.</div> </div> |                                                                                                   | <div> <div>QAP GUIDELINES &amp; FORMAT</div> <div>( ANNEXURE -7 )</div> <div> <p>The QAP format and guidelines for filling up the format shall be used by vendor for preparation and submission of QAP after order placement.</p> <p><b>Note :</b></p> <ol style="list-style-type: none"> <li>1. Typical /Indicative /Standard QAP(s) for equipment /package attached is reference document and to use by successful bidder in future for preparation and submission of QAP for BHEL /CUSTOMER approval.</li> <li>2. No deviation to reference document is acceptable.</li> </ol> </div> </div> |                                         |

|                                                                                                                                                                                                                                                             |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                              |                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
|                                                                                                                                                                                                                                                             | Form No. | <br><b>HYDERABAD</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p align="center"><b>PRODUCT STANDARD</b></p> <p align="center">PROJECT ENGINEERING &amp; SYSTEMS DIVISION<br/>HYDERABAD</p> | ANNEXURE<br>Rev No. 00<br>Page 2 of 3 |
| <p align="center"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED .<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> |          | <p align="center"><b><u>GUIDELINES TO VENDORS FOR<br/>PREPARATION OF QUALITY ASSURANCE PLAN</u></b></p> <ol style="list-style-type: none"> <li>QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.</li> <li>Each page of QAP shall contain the following information.             <ol style="list-style-type: none"> <li>Vendor's name &amp; address.</li> <li>Customer: BHEL, Hyderabad.</li> <li>Project.</li> <li>BHEL Product Standard Number/revision number as referred in P.O.</li> <li>BHEL Purchase Order Number &amp; Date.</li> <li>Product as per P.O. description.</li> <li>QAP Number (unique and shall not repeat)/revision number/date.</li> <li>Page number and number of pages</li> </ol> </li> <li>QAP shall contain four parts / stages as follows.             <ol style="list-style-type: none"> <li>Raw materials and bought out items.</li> <li>In process Control / Inspection.</li> <li>Final assembly, Inspection &amp; Testing.</li> <li>Painting, preservation &amp; packing.</li> </ol> </li> <li>Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).</li> <li>Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc.), hydrostatic test, calibration check etc.)</li> <li>Under 'Class', indicate minor, major or critical depending on the importance of characteristic.</li> <li>Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)</li> <li>Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)</li> <li>Under 'Reference document' and 'Acceptance norms', appropriate National &amp; International standards, BHEL standards, approved drawing references etc. should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practice etc.". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review &amp; approval by our Engineering dept.</li> <li>Under 'Format of record', indicate appropriately supplier's test certificate, calibration certificate, lab report, inspection report etc.</li> </ol> |                                                                                                                              |                                       |
|                                                                                                                                                                                                                                                             | Ref. Doc | <ol style="list-style-type: none"> <li>Please refer 'Agency' in QAP format.<br/>             Under P: Perform, W: Witness, V: Verify<br/>             Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR<br/>             2: (Vendor / Sub vendor)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                              |                                       |



|                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                              |                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Form No.                                                                                                                                                                                                                                                    | <br><b>HYDERABAD</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p align="center"><b>PRODUCT STANDARD</b></p> <p align="center">PROJECT ENGINEERING &amp; SYSTEMS DIVISION<br/>HYDERABAD</p> | <p>ANNEXURE</p> <p>Rev No. 00</p> <p>Page 3 of 3</p> |
| <p align="center"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED .<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <p>Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, Under Witness (W) column use 1. Under 'Verify' column, use code1.</p> <p>12. Under 'D' please put (<input type="checkbox"/> Tick) against each characteristic where vendor proposes to submit test certificate/report etc. OR as required as per BHEL Specification.</p> <p>13. Vendor's signature &amp; stamp should be available on each page of QAP.</p> <p>14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification &amp; Approved Drawings.</p> <p>15. The following operations/characteristics/check points may be included (AS APPROPRIATE)</p> <ul style="list-style-type: none"> <li>a) Visual check</li> <li>b) Dimensional check</li> <li>c) Mechanical and Chemical properties.</li> <li>d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc. as the case may be.)</li> <li>e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc.</li> <li>f) Check for correctness for all components mounted as per General arrangement Drawing, Bill Of Materials (BOM), etc. for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.</li> <li>g) Verification of test certificate for protection class for the enclosures.</li> <li>h) Mechanical functioning of switches.</li> <li>i) Continuity of earthing and provision of earth points.</li> <li>j) Colour coding of wiring, size, tightness &amp; dressing of wiring.</li> <li>k) Review of test certificates of assembled items, raw materials, internal test reports etc.</li> <li>l) Witness of functional checks, which may include mechanical run &amp; electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.</li> <li>m) PQR, WPS, Welder Qualification Record, welding records (fit up, DP) etc.</li> <li>n) Material identification ( for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc.)</li> <li>o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non-Destructive Tests.</li> <li>p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Pierce Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)</li> <li>q) All tests as per BHEL Product Standard &amp; approved drawings including Type tests and Routine tests on individual items and on System as a whole.</li> <li>r) Packing and Preservation.</li> </ul> <p>16. <b>QAP Format enclosed.</b></p> <p>17. <b>Typical Manufacturing QAP(s) is /are attached.</b></p> |                                                                                                                              |                                                      |
|                                                                                                                                                                                                                                                             | Ref. Doc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |                                                      |

| VENDOR'S NAME & ADDRESS: |                                             | <b>MANUFACTURING QUALITY PLAN</b> |       |               |                  |                         |                  |                  | QP. NO.: |                 |             |  |         |
|--------------------------|---------------------------------------------|-----------------------------------|-------|---------------|------------------|-------------------------|------------------|------------------|----------|-----------------|-------------|--|---------|
|                          |                                             | CUSTOMER: BHEL, HYDERABAD – 32.   |       |               |                  | BHEL P.O.NO.:           |                  |                  | REV NO:  |                 | DATE:       |  |         |
|                          |                                             | PROJECT:<br>PRODUCT:              |       |               |                  | P.O.DATE:<br>BHEL SPEC: |                  |                  | REV:     |                 | PAGE 1 OF 1 |  |         |
| SL NO                    | COMPONENTS                                  | CHARACTERISTICS                   | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT      | ACCEPTANCE NORMS | FORMAT OF RECORD | * D      | AGENCY<br>P W V |             |  | REMARKS |
| 1.0                      | <b>RAW MATERIALS &amp; BOUGHT OUT ITEMS</b> |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
| 2.0                      | <b>INPROCESS INSPECTION</b>                 |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
| 3.0                      | <b>FINAL INSPECTION &amp; TESTING</b>       |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
| 4.0                      | <b>PRESERVATION &amp; PACKING</b>           |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |
|                          |                                             |                                   |       |               |                  |                         |                  |                  |          |                 |             |  |         |

**VENDOR TO NOTE:** THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

|                                                                                                                                                                                                                                                                                                                             |                            |                           |                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------|------------------------------|
| LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS. | PREPARED BY                | APPROVED BY               | APPROVED BY                  |
|                                                                                                                                                                                                                                                                                                                             | VENDOR'S SIGNATURE & STAMP | BHEL QA SIGNATURE & STAMP | CUSTOMER'S SIGNATURE & STAMP |

|                                                                                  |                                    |                                                                         |       |                           |                                                          |                                                    |                  |                   |    |        |   |     |         |
|----------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------|-------|---------------------------|----------------------------------------------------------|----------------------------------------------------|------------------|-------------------|----|--------|---|-----|---------|
|  |                                    | TYPICAL MANUFACTURING QUALITY PLAN                                      |       |                           |                                                          |                                                    |                  | MQP. NO.:         |    |        |   |     |         |
|                                                                                  |                                    | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |       |                           | PROJECT:<br>PACKAGE: CENTRIFUGAL PUMP<br>BHEL TECH SPEC: |                                                    |                  | REV NO:           |    | DATE:  |   |     |         |
|                                                                                  |                                    |                                                                         |       |                           |                                                          |                                                    |                  | PAGE 1 OF 4       |    |        |   |     |         |
| SL NO                                                                            | COMPONENTS                         | CHARACTERISTICS                                                         | CLASS | TYPE OF CHECK             | QUANTUM OF CHECK                                         | REFERENCE DOCUMENT                                 | ACCEPTANCE NORMS | FORMAT OF RECORD  | *D | AGENCY |   |     | REMARKS |
|                                                                                  |                                    |                                                                         |       |                           |                                                          |                                                    |                  |                   |    | P      | W | V   |         |
| 1.0                                                                              | RAW MATERIALS & BOUGHT OUT ITEMS   |                                                                         |       |                           |                                                          |                                                    |                  |                   |    |        |   |     |         |
| 1.1                                                                              | Casing                             | Visual check                                                            | Major | Visual                    | 100%                                                     | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | --                | -- | 2      | 2 | --  |         |
| 1.2                                                                              |                                    | Dimensional check                                                       | Major | Measurements              | 100%                                                     |                                                    |                  | --                | -- | 2      | 2 | --  |         |
| 1.3                                                                              |                                    | Chemical & Mech. Properties                                             | Major | Chemical & Mech. analysis | 1 per heat/lot                                           |                                                    |                  | MTC               | √  | 2      | 2 | 1&3 |         |
| 1.4                                                                              |                                    | Heat treatment for all castings                                         | Major | HT                        | 100%                                                     |                                                    |                  | HT chart          | √  | 2      | 2 | 1&3 |         |
| 1.5                                                                              | Impeller, Diffuser and Shaft       | Chemical & Mech. Properties                                             | Major | Chemical & Mech. analysis | 1 per heat/lot                                           |                                                    |                  | MTC               | √  | 2      | 2 | 1&3 |         |
| 1.6                                                                              | Mechanical seal                    | Material and leakage check (Air test)                                   | Major | OEM's certificate review  | 100%                                                     |                                                    |                  | OEM's certificate | √  | 2      | 2 | 1&3 |         |
| 1.7                                                                              | Bearing and bearing housing        | Make and Model                                                          | Major | OEM's certificate review  | 100%                                                     |                                                    |                  | OEM's certificate | √  | 2      | 2 | 1&3 |         |
| 1.8                                                                              | Coupling                           | Chemical & Mech. Properties                                             | Major | Chemical & Mech. analysis | 1 per heat/lot                                           |                                                    |                  | MTC               | √  | 2      | 2 | 1&3 |         |
| 1.9                                                                              | Strainer (as applicable)           | Chemical & Mech. Properties and hydro test                              | Major | OEM's certificate review  | 100%                                                     |                                                    |                  | OEM's certificate | √  | 2      | 2 | 1&3 |         |
| 1.10                                                                             | Instruments and JB (as applicable) | MOC, hydro test reports, Calibration reports and Type test certificates | 100%  | OEM's certificate review  | 100%                                                     |                                                    |                  | OEM's certificate | √  | 2      | 2 | 1&3 |         |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                                                                                                                                                                                                                                             |                                                    | TYPICAL MANUFACTURING QUALITY PLAN     |          |                                              |                                              |                                                    |                  | MQP. NO.:                    |    |        |   |     |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------------------|----------|----------------------------------------------|----------------------------------------------|----------------------------------------------------|------------------|------------------------------|----|--------|---|-----|---------|
|                                                                                                                                                                                                                                                                                                                             |                                                    | PROJECT ENGINEERING & SYSTEMS          |          |                                              | PROJECT:                                     |                                                    |                  | REV NO:                      |    | DATE:  |   |     |         |
|                                                                                                                                                                                                                                                                                                                             |                                                    | DIVISION BHEL,<br>RC PURAM, HYD-502032 |          |                                              | PACKAGE: CENTRIFUGAL PUMP<br>BHEL TECH SPEC: |                                                    |                  | PAGE 2 OF 4                  |    |        |   |     |         |
| SL NO                                                                                                                                                                                                                                                                                                                       | COMPONENTS                                         | CHARACTERISTICS                        | CLASS    | TYPE OF CHECK                                | QUANTUM OF CHECK                             | REFERENCE DOCUMENT                                 | ACCEPTANCE NORMS | FORMAT OF RECORD             | *D | AGENCY |   |     | REMARKS |
|                                                                                                                                                                                                                                                                                                                             |                                                    |                                        |          |                                              |                                              |                                                    |                  |                              |    | P      | W | V   |         |
| 1.11                                                                                                                                                                                                                                                                                                                        | Interconnecting pipes and fittings (as applicable) | Chemical & Mech. Properties            | Major    | Chemical & Mech. Analysis                    | 1 per heat/lot                               |                                                    |                  | MTC                          | √  | 2      | 2 | 1&3 |         |
| 1.12                                                                                                                                                                                                                                                                                                                        | Wear rings, Gaskets, Flanges, and Fasteners        | Chemical & Mech. Properties            | Minor    | Chemical & Mech. Analysis                    | 1 per heat/lot                               |                                                    |                  | MTC                          | √  | 2      | 2 | 1&3 |         |
| 2.0                                                                                                                                                                                                                                                                                                                         | INPROCESS INSPECTION                               |                                        |          |                                              |                                              |                                                    |                  |                              |    |        |   |     |         |
| 2.1                                                                                                                                                                                                                                                                                                                         | Fabrication of casing and other components         | WPS, PQR and WQR                       | Major    | Document verification                        | 100%                                         | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | WPS, PQR and WQR             | -- | 2      | 2 | 1&3 |         |
| 2.2                                                                                                                                                                                                                                                                                                                         | Casing                                             | NDE                                    | Major    | DPT/MPI                                      | 100%                                         |                                                    |                  | NDE reports                  | √  | 2      | 1 | 1&3 |         |
| 2.3                                                                                                                                                                                                                                                                                                                         |                                                    | Leakage                                | Critical | Hydrostatic test                             | 100%                                         |                                                    |                  | Test reports                 | √  | 2      | 1 | 1&3 |         |
| 2.4                                                                                                                                                                                                                                                                                                                         | Butt welds on casing (if any)                      | NDE                                    | Major    | RT                                           | 100%                                         |                                                    |                  | IR                           | √  | 2      | 2 | 1&3 |         |
| 2.5                                                                                                                                                                                                                                                                                                                         | Fillet welds on casing (if any)                    | NDE                                    | Major    | MPI                                          | 100%                                         |                                                    |                  | IR                           | √  | 2      | 2 | 1&3 |         |
| 2.6                                                                                                                                                                                                                                                                                                                         | Impeller and Diffuser                              | NDE                                    | Major    | DPT / MPI                                    | 100%                                         |                                                    |                  | NDE reports                  | √  | 2      | 2 | 1&3 |         |
| 2.7                                                                                                                                                                                                                                                                                                                         | Shaft                                              | NDE                                    | Major    | DPT / MPI and UT (if shaft diameter > 50 mm) | 100%                                         |                                                    |                  | NDE reports                  | √  | 2      | 2 | 1&3 |         |
| 2.8                                                                                                                                                                                                                                                                                                                         | Wear rings                                         | NDE and hardness test                  | Major    | DPT and hardness test                        | 100%                                         |                                                    |                  | DP and hardness test reports | √  | 2      | 2 | 1&3 |         |
| LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS. |                                                    |                                        |          |                                              |                                              |                                                    |                  |                              |    |        |   |     |         |

|                                                                                  |                                                                         |                                                                         |          |                    |                                                          |                                                                         |                  |                           |    |        |     |     |                                                             |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|----------|--------------------|----------------------------------------------------------|-------------------------------------------------------------------------|------------------|---------------------------|----|--------|-----|-----|-------------------------------------------------------------|
|  |                                                                         | TYPICAL MANUFACTURING QUALITY PLAN                                      |          |                    |                                                          |                                                                         |                  | MQP. NO.:                 |    |        |     |     |                                                             |
|                                                                                  |                                                                         | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |          |                    | PROJECT:<br>PACKAGE: CENTRIFUGAL PUMP<br>BHEL TECH SPEC: |                                                                         |                  | REV NO:                   |    | DATE:  |     |     |                                                             |
|                                                                                  |                                                                         |                                                                         |          |                    |                                                          |                                                                         |                  | PAGE 3 OF 4               |    |        |     |     |                                                             |
| SL NO                                                                            | COMPONENTS                                                              | CHARACTERISTICS                                                         | CLASS    | TYPE OF CHECK      | QUANTUM OF CHECK                                         | REFERENCE DOCUMENT                                                      | ACCEPTANCE NORMS | FORMAT OF RECORD          | *D | AGENCY |     |     | REMARKS                                                     |
|                                                                                  |                                                                         |                                                                         |          |                    |                                                          |                                                                         |                  |                           |    | P      | W   | V   |                                                             |
| 2.9                                                                              | Interconnecting Piping (as applicable)                                  | NDE and leakage                                                         | Major    | DPT and hydro test | 100%                                                     |                                                                         |                  | DPT and hydro test report | √  | 2      | 2   | 1&3 |                                                             |
| 2.10                                                                             | Coupling                                                                | Dynamic balancing                                                       | Critical | Balancing          | 100%                                                     |                                                                         |                  | IR                        | √  | 2      | 2   | 1&3 |                                                             |
| 2.11                                                                             | Impeller                                                                | Dynamic balancing                                                       | Critical | Balancing          | 100%                                                     |                                                                         |                  | IR                        | √  | 2      | 2   | 1&3 |                                                             |
| 2.12                                                                             | Rotor assembly with coupling half                                       | Dynamic balancing                                                       | Critical | Balancing          | 100%                                                     |                                                                         |                  | IR                        | √  | 2      | 2   | 1&3 |                                                             |
| 3.0                                                                              | FINAL INSPECTION & TESTING                                              |                                                                         |          |                    |                                                          |                                                                         |                  |                           |    |        |     |     |                                                             |
| 3.1                                                                              | Motor driven pump with job motor and engine driven pump with Job engine | Overall Dimensions                                                      | Major    | Measurement        | 100%                                                     | Tech Spec/ Approved Datasheet/ Approved Drawing/Approved test procedure |                  | TC                        | √  | 2      | 2   | 1&3 | 100% witness by BHEL/ BHEL's TPIA & TSGENCO/ TSGENCO's TPIA |
| 3.2                                                                              |                                                                         | Performance test                                                        | Critical | Testing            | 100%                                                     |                                                                         |                  | IR                        | √  | 2      | 1&3 | 1&3 |                                                             |
| 3.3                                                                              |                                                                         | NPSH test (if NPSHa - NPSHr is < than 1 meter)                          | Major    | Testing            | 100%                                                     |                                                                         |                  | TC                        | √  | 2      | 1&3 | 1&3 |                                                             |
| 3.4                                                                              |                                                                         | Submergence test (for vertical pumps)                                   | Major    | Testing            | 100%                                                     |                                                                         |                  | TC                        | √  | 2      | 1&3 | 1&3 |                                                             |
| 3.5                                                                              |                                                                         | Mechanical run test                                                     | Critical | Testing            | 100%                                                     |                                                                         |                  | TC                        | √  | 2      | 1&3 | 1&3 |                                                             |
| 3.6                                                                              |                                                                         | Strip Examination                                                       | Major    | Dismantling        | 100%                                                     |                                                                         |                  |                           |    | 2      | 1&3 | 1&3 |                                                             |
| 3.7                                                                              |                                                                         | Complete unit test                                                      | Major    | Testing            | 100%                                                     |                                                                         |                  | TC                        | √  | 2      | 1&3 | 1&3 |                                                             |
| 3.8                                                                              |                                                                         | Accessories and Spares (if any)                                         | Major    | BOM check          | 100%                                                     |                                                                         |                  | IR                        | √  | 2      | 1&3 | 1&3 |                                                             |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                                                                                  |                         |                                                                         |       |                     |                                                          |                                                    |                  |                  |             |        |       |    |                                       |
|----------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------|-------|---------------------|----------------------------------------------------------|----------------------------------------------------|------------------|------------------|-------------|--------|-------|----|---------------------------------------|
|  |                         | TYPICAL MANUFACTURING QUALITY PLAN                                      |       |                     |                                                          |                                                    |                  |                  | MQP. NO.:   |        |       |    |                                       |
|                                                                                  |                         | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |       |                     | PROJECT:<br>PACKAGE: CENTRIFUGAL PUMP<br>BHEL TECH SPEC: |                                                    |                  |                  | REV NO:     |        | DATE: |    |                                       |
|                                                                                  |                         |                                                                         |       |                     |                                                          |                                                    |                  |                  | PAGE 4 OF 4 |        |       |    |                                       |
| SL NO                                                                            | COMPONENTS              | CHARACTERISTICS                                                         | CLASS | TYPE OF CHECK       | QUANTUM OF CHECK                                         | REFERENCE DOCUMENT                                 | ACCEPTANCE NORMS | FORMAT OF RECORD | *D          | AGENCY |       |    | REMARKS                               |
|                                                                                  |                         |                                                                         |       |                     |                                                          |                                                    |                  |                  |             | P      | W     | V  |                                       |
| 4.0                                                                              | PRESERVATION & PACKING  |                                                                         |       |                     |                                                          |                                                    |                  |                  |             |        |       |    |                                       |
| 4.1                                                                              | Pump and its components | Direction of rotation, Stamping and Painting                            | Major | Visual, Shade & DFT | Random                                                   | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | IR               | √           | 2      | 2     | 1  |                                       |
| 4.2                                                                              |                         | Inspection reports/ certificate traceability index                      | Major | Visual              | 100%                                                     |                                                    |                  | Index            | √           | 2      | 2     | 1  |                                       |
| 4.3                                                                              |                         | Packing #                                                               | Major | Visual              | 100%                                                     |                                                    |                  | Packing List     | √           | 2      | 2     | -- | # Seaworthy packing for export orders |

**Notes:-**

1. This MQP should be read along with specification, approved drawings & approved datasheet. (Latest revisions to be considered as per PO).
2. Specification/Drawing/datasheet shall prevail over quality plan for contradiction if any.
3. Any project/customer specific requirements which shall be notified have to be fulfilled by the vendor at the time of execution of order.
4. PMI to be witness by inspection agency for all accessible SS or AS parts.

**Abbreviations:-**

|     |   |                                  |            |   |                                  |
|-----|---|----------------------------------|------------|---|----------------------------------|
| MTC | - | Material Test certificate        | WPS        | - | Welding Procedure Specification  |
| IBR | - | Indian Boiler Regulations        | PQR        | - | Procedure Qualification Record   |
| DFT | - | Dry Film Thickness               | WPQ        | - | Welder Performance Qualification |
| TC  | - | Test Certificate                 | NDE        | - | Non Destructive Examination      |
| UTS | - | Ultimate Tensile Strength        | Appd. Dwg. | - | Approved Drawing                 |
| PMI | - | Positive Material Identification | OD         | - | Outer Diameter                   |
| G.I | - | Galvanized Iron                  | ID         | - | Internal Diameter                |
| MOC | - | Material of construction         |            |   |                                  |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                                                                                  |            |                                                                         |       |               |                                                  |                    |                  |                  |             |        |   |   |         |
|----------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------|-------|---------------|--------------------------------------------------|--------------------|------------------|------------------|-------------|--------|---|---|---------|
|  |            | TYPICAL MANUFACTURING QUALITY PLAN                                      |       |               |                                                  |                    |                  |                  | MQP. NO.:   |        |   |   |         |
|                                                                                  |            | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |       |               | PROJECT:<br>PACKAGE: LT MOTOR<br>BHEL TECH SPEC: |                    | REV NO:          | DATE:            | PAGE 1 OF 4 |        |   |   |         |
|                                                                                  |            |                                                                         |       |               |                                                  |                    |                  |                  |             |        |   |   |         |
| SL NO                                                                            | COMPONENTS | CHARACTERISTICS                                                         | CLASS | TYPE OF CHECK | QUANTUM OF CHECK                                 | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * D         | AGENCY |   |   | REMARKS |
|                                                                                  |            |                                                                         |       |               |                                                  |                    |                  |                  |             | P      | W | V |         |

|                                                                                                                                                                                                                                                                                                                             |                                                              |                                                                                                                                               |       |                                                 |                         |                                                                                                       |                                |    |   |   |   |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------|----|---|---|---|--|--|
| 1.0 RAW MATERIALS & BOUGHT OUT ITEMS                                                                                                                                                                                                                                                                                        |                                                              |                                                                                                                                               |       |                                                 |                         |                                                                                                       |                                |    |   |   |   |  |  |
| 1.1                                                                                                                                                                                                                                                                                                                         | <u>COPPER WIRE</u><br>Enameled Copper Wire                   | Overall diameter, elongation, Mandrel winding test, Peel test, springiness, Abrasion test, Cut through test, Heat shock test, Continuity test | Major | Measurement and mechanical & electrical testing | One sample per heat/lot | National & international standard ( IS or IEC) / technical specification/ approved drawing/ datasheet | IR / supplier test certificate | √  | 2 | 2 | 1 |  |  |
| 1.2                                                                                                                                                                                                                                                                                                                         | <u>STEEL SHAFT</u><br>Straightened Steel bar in black Finish | Dimensions, surface finish, chemical composition                                                                                              | Major | Visual, measurement and chemical testing        | One sample per heat/lot |                                                                                                       | supplier test certificate      | √  | 2 | 2 | 1 |  |  |
| 1.3                                                                                                                                                                                                                                                                                                                         |                                                              | NDT                                                                                                                                           | Major | UT                                              | 100%                    |                                                                                                       | supplier test certificate      | √  | 2 | 2 | 1 |  |  |
| 1.4                                                                                                                                                                                                                                                                                                                         | <u>ALUMINIUM INGOTS</u>                                      | Chemical properties                                                                                                                           | Major | Chemical testing                                | One sample per heat/lot |                                                                                                       | supplier test certificate      | √  | 2 | 2 | 1 |  |  |
| 2.0 INPROCESS INSPECTION                                                                                                                                                                                                                                                                                                    |                                                              |                                                                                                                                               |       |                                                 |                         |                                                                                                       |                                |    |   |   |   |  |  |
| 2.1                                                                                                                                                                                                                                                                                                                         | ASSEMBLY                                                     | Completeness and correctness of assembly                                                                                                      | Major | Visual verification                             | 100%                    | MO and manufacturer's internal processes                                                              | Log book                       | -- | 2 | 2 | 2 |  |  |
| LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS. |                                                              |                                                                                                                                               |       |                                                 |                         |                                                                                                       |                                |    |   |   |   |  |  |

|                                                                                                                                                                                                                                             |                 | <b>TYPICAL MANUFACTURING QUALITY PLAN</b>                               |       |               |                                                  |                                                                          |                  | MQP. NO.:        |   |        |   |     |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------|-------|---------------|--------------------------------------------------|--------------------------------------------------------------------------|------------------|------------------|---|--------|---|-----|---------|
|                                                                                                                                                                                                                                                                                                                             |                 |                                                                         |       |               |                                                  |                                                                          |                  | REV NO:          |   | DATE:  |   |     |         |
|                                                                                                                                                                                                                                                                                                                             |                 | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |       |               | PROJECT:<br>PACKAGE: LT MOTOR<br>BHEL TECH SPEC: |                                                                          |                  | PAGE 2 OF 4      |   |        |   |     |         |
| SL NO                                                                                                                                                                                                                                                                                                                       | COMPONENTS      | CHARACTERISTICS                                                         | CLASS | TYPE OF CHECK | QUANTUM OF CHECK                                 | REFERENCE DOCUMENT                                                       | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY |   |     | REMARKS |
|                                                                                                                                                                                                                                                                                                                             |                 |                                                                         |       |               |                                                  |                                                                          |                  |                  | D | P      | W | V   |         |
| <b>3.0 FINAL INSPECTION &amp; TESTING</b>                                                                                                                                                                                                                                                                                   |                 |                                                                         |       |               |                                                  |                                                                          |                  |                  |   |        |   |     |         |
| 3.1                                                                                                                                                                                                                                                                                                                         | ROUTINE TESTING | Measurement of winding resistance in cold condition                     | Major | Testing       | 100%                                             | National & international standard ( IS or IEC) / technical specification |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.2                                                                                                                                                                                                                                                                                                                         |                 | SH heater resistance (if applicable)                                    | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.3                                                                                                                                                                                                                                                                                                                         |                 | Insulation resistance (before and after HV test)                        | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.4                                                                                                                                                                                                                                                                                                                         |                 | High voltage test at 1.8 KV for 1 minute and space heater HV test       | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.5                                                                                                                                                                                                                                                                                                                         |                 | Direction of rotation                                                   | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.6                                                                                                                                                                                                                                                                                                                         |                 | No load test (measurement of NL A, voltage, NL power and NL RPM)        | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.7                                                                                                                                                                                                                                                                                                                         |                 | Reduced run up voltage test at ( rated volt√3)                          | Major | Testing       | 100%100%                                         |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.8                                                                                                                                                                                                                                                                                                                         |                 | Locked rotor test at full load current                                  | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.9                                                                                                                                                                                                                                                                                                                         |                 | Vibration measurement                                                   | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.10                                                                                                                                                                                                                                                                                                                        |                 | Measurement of noise level                                              | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| 3.11                                                                                                                                                                                                                                                                                                                        |                 | 120% over speed test                                                    | Major | Testing       | 100%                                             |                                                                          |                  | TC               | √ | 2      | 1 | 1&3 |         |
| LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS. |                 |                                                                         |       |               |                                                  |                                                                          |                  |                  |   |        |   |     |         |



|  |            | <b>TYPICAL MANUFACTURING QUALITY PLAN</b>                                                     |       |               |                                                  |                                                                          |                  | MQP. NO.:        |     |        |   |     |                                                           |                                                                                             |
|----------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------|-------|---------------|--------------------------------------------------|--------------------------------------------------------------------------|------------------|------------------|-----|--------|---|-----|-----------------------------------------------------------|---------------------------------------------------------------------------------------------|
|                                                                                  |            |                                                                                               |       |               |                                                  |                                                                          |                  | REV NO:          |     | DATE:  |   |     |                                                           |                                                                                             |
|                                                                                  |            | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032                       |       |               | PROJECT:<br>PACKAGE: LT MOTOR<br>BHEL TECH SPEC: |                                                                          |                  | PAGE 3 OF 4      |     |        |   |     |                                                           |                                                                                             |
| SL NO                                                                            | COMPONENTS | CHARACTERISTICS                                                                               | CLASS | TYPE OF CHECK | QUANTUM OF CHECK                                 | REFERENCE DOCUMENT                                                       | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY |   |     | REMARKS                                                   |                                                                                             |
|                                                                                  |            |                                                                                               |       |               |                                                  |                                                                          |                  |                  | P   | W      | V |     |                                                           |                                                                                             |
| 3.12                                                                             | TYPE TESTS | Measurement of winding resistance in cold condition                                           | Major | Testing       | One /rating                                      | National & international standard ( IS or IEC) / technical specification |                  | TC               | √   | 2      | 1 | 1&3 | Verification of Identical Type test Report of same Rating |                                                                                             |
| 3.13                                                                             |            | Temp. rise test at full load ( load point for 100%, 75% & 50% load ( full load, ¾ and ½ load) | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.14                                                                             |            | 160% momentary overload test                                                                  | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.15                                                                             |            | Locked rotor amp and torque test                                                              | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.16                                                                             |            | No load test                                                                                  | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           | Identical type test reports for motor ratings (not more than 5 years old) will be provided. |
| 3.17                                                                             |            | Reduced voltage running up test                                                               | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.18                                                                             |            | Insulation resistance test ( before and after HV test)                                        | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.19                                                                             |            | HV test – 1.8 KV for winding and 1.5 KV for space heater                                      | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.20                                                                             |            | Vibration test                                                                                | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |
| 3.21                                                                             |            | 120% over speed test                                                                          | Major | Testing       | One /rating                                      |                                                                          |                  | TC               | √   | 2      | 1 | 1&3 |                                                           |                                                                                             |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                                                                                  |                        |                                                                         |       |                     |                                                  |                                                        |                  |                  |   |        |    |   |         |
|----------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------|-------|---------------------|--------------------------------------------------|--------------------------------------------------------|------------------|------------------|---|--------|----|---|---------|
|  |                        | <b>TYPICAL MANUFACTURING QUALITY PLAN</b>                               |       |                     |                                                  |                                                        |                  | MQP. NO.:        |   |        |    |   |         |
|                                                                                  |                        |                                                                         |       |                     |                                                  |                                                        |                  | REV NO:          |   | DATE:  |    |   |         |
|                                                                                  |                        | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |       |                     | PROJECT:<br>PACKAGE: LT MOTOR<br>BHEL TECH SPEC: |                                                        |                  | PAGE 4 OF 4      |   |        |    |   |         |
| SL NO                                                                            | COMPONENTS             | CHARACTERISTICS                                                         | CLASS | TYPE OF CHECK       | QUANTUM OF CHECK                                 | REFERENCE DOCUMENT                                     | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY |    |   | REMARKS |
|                                                                                  |                        |                                                                         |       |                     |                                                  |                                                        |                  |                  | D | P      | W  | V |         |
| 4.0                                                                              | PRESERVATION & PACKING |                                                                         |       |                     |                                                  |                                                        |                  |                  |   |        |    |   |         |
|                                                                                  |                        | Painting*,<br>(Shade, DFT,) Marking                                     | Major | Visual, Measurement | Random                                           | Technical specification/<br>approved drawing/datasheet | TC               | √                | 2 | --     | 1  |   |         |
|                                                                                  |                        | Packing*                                                                | Major | Visual              | Random                                           |                                                        | Packing List     | √                | 2 | --     | -- |   |         |

**Notes:-**

1. This MQP should be read along with specification ((Latest revisions to be considered as per PO), approved drawings & approved datasheet.
2. Specification/drawing/datasheet shall prevail over quality plan for contradiction if any.
3. Any project/customer specific requirements which shall be notified have to be fulfilled by the vendor at the time of execution of order.

**Abbreviations:-**

|     |   |                           |     |   |                             |     |   |                    |
|-----|---|---------------------------|-----|---|-----------------------------|-----|---|--------------------|
| MTC | – | Material Test certificate | COC | – | Certificate of Compliance   | DFT | – | Dry Film Thickness |
| TC  | – | Test Certificate          | NDE | – | Non Destructive Examination | IR  | – | Inspection Report  |
| DFT | – | Dry Film Thickness        | IBR | – | Indian Boiler Regulations   | IS  | – | Indian Standards   |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                                                                                  |                                                             |                                                                         |          |                       |                                                       |                                                    |                  |                  |     |        |   |     |         |
|----------------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------------------|----------|-----------------------|-------------------------------------------------------|----------------------------------------------------|------------------|------------------|-----|--------|---|-----|---------|
|  |                                                             | TYPICAL MANUFACTURING QUALITY PLAN                                      |          |                       |                                                       |                                                    |                  | MQP. NO.:        |     |        |   |     |         |
|                                                                                  |                                                             | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |          |                       | PROJECT:<br>PACKAGE: DIESEL ENGINE<br>BHEL TECH SPEC: |                                                    |                  | REV NO:          |     | DATE:  |   |     |         |
|                                                                                  |                                                             |                                                                         |          |                       |                                                       |                                                    |                  | PAGE 1 OF 2      |     |        |   |     |         |
| SL NO                                                                            | COMPONENTS                                                  | CHARACTERISTICS                                                         | CLASS    | TYPE OF CHECK         | QUANTUM OF CHECK                                      | REFERENCE DOCUMENT                                 | ACCEPTANCE NORMS | FORMAT OF RECORD | * D | AGENCY |   |     | REMARKS |
|                                                                                  |                                                             |                                                                         |          |                       |                                                       |                                                    |                  |                  |     | P      | W | V   |         |
| 1.0 RAW MATERIALS & BOUGHT OUT ITEMS                                             |                                                             |                                                                         |          |                       |                                                       |                                                    |                  |                  |     |        |   |     |         |
| 1.1                                                                              | Piston crown,<br>Connecting rod,<br>Crankshaft,<br>Camshaft | Chem. & mech. properties                                                | Major    | Chem. & mech. Testing | 1 per lot/heat                                        | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | MTC              | √   | 2      | 2 | 1&3 |         |
| 1.2                                                                              |                                                             | Crack test                                                              | Major    | NDE                   | 100%                                                  |                                                    |                  | MTC              | √   | 2      | 2 | 1&3 |         |
| 1.3                                                                              |                                                             | Dimensions                                                              | Major    | Measure ment          | 100%                                                  |                                                    |                  | MTC              | √   | 2      | 2 | 1&3 |         |
| 1.4                                                                              | Cylinder block,<br>Cylinder head,<br>Cylinder liner         | Chem. & mech. properties                                                | Major    | Chem. & mech. Testing | 1 per lot/heat                                        |                                                    |                  | MTC              | √   | 2      | 2 | 1&3 |         |
| 1.5                                                                              |                                                             | Pressure test                                                           | Major    | Hydro test            | 100%                                                  |                                                    |                  | MTC              | √   | 2      | 2 | 1&3 |         |
| 1.6                                                                              |                                                             | Dimensions                                                              | Major    | Measure ment          | 100%                                                  |                                                    |                  | MTC              | √   | 2      | 2 | 1&3 |         |
| 2.0 INPROCESS INSPECTION                                                         |                                                             |                                                                         |          |                       |                                                       |                                                    |                  |                  |     |        |   |     |         |
| 2.1                                                                              | Crankshaft                                                  | Dynamic balancing                                                       | Critical | balancing             | 100%                                                  | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | IR               | √   | 2      | 2 | 1   |         |
| 2.2                                                                              | Fuel, Lube oil pump and control panel                       | Functional test                                                         | Major    | Testing               | 100%                                                  |                                                    |                  | TC               | √   | 2      | 2 | 1   |         |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                                                                                  |                                  |                                                                         |          |                     |                                                       |                                                    |                  |                  |             |   |        |     |                                                                                             |         |
|----------------------------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------|----------|---------------------|-------------------------------------------------------|----------------------------------------------------|------------------|------------------|-------------|---|--------|-----|---------------------------------------------------------------------------------------------|---------|
|  |                                  | TYPICAL MANUFACTURING QUALITY PLAN                                      |          |                     |                                                       |                                                    |                  |                  | MQP. NO.:   |   |        |     |                                                                                             |         |
|                                                                                  |                                  | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |          |                     | PROJECT:<br>PACKAGE: DIESEL ENGINE<br>BHEL TECH SPEC: |                                                    |                  |                  | REV NO:     |   | DATE:  |     |                                                                                             |         |
|                                                                                  |                                  |                                                                         |          |                     |                                                       |                                                    |                  |                  | PAGE 2 OF 2 |   |        |     |                                                                                             |         |
| SL NO                                                                            | COMPONENTS                       | CHARACTERISTICS                                                         | CLASS    | TYPE OF CHECK       | QUANTUM OF CHECK                                      | REFERENCE DOCUMENT                                 | ACCEPTANCE NORMS | FORMAT OF RECORD | *           | D | AGENCY |     |                                                                                             | REMARKS |
|                                                                                  |                                  |                                                                         |          |                     |                                                       |                                                    |                  |                  |             |   | P      | W   | V                                                                                           |         |
| 3.0                                                                              | FINAL INSPECTION & TESTING       |                                                                         |          |                     |                                                       |                                                    |                  |                  |             |   |        |     |                                                                                             |         |
| 3.1                                                                              | Diesel engine                    | Performance test                                                        | Critical | Testing             | 100%                                                  | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | TC               | √           | 2 | 1      | 1&3 | Only 10% witness by BHEL / BHEL's TPIA, subjective to minimum 1 engine of each size & type. |         |
| 3.2                                                                              |                                  | Overall Dimensions                                                      | Major    | Measure ment        | 100%                                                  |                                                    |                  | IR               | √           | 2 | 1      | 1&3 |                                                                                             |         |
| 3.3                                                                              |                                  | Spares (if any)                                                         | Major    | BOM check           | 100%                                                  |                                                    |                  | IR               | √           | 2 | 1      | 1&3 |                                                                                             |         |
| 4.0                                                                              | PRESERVATION & PACKING           |                                                                         |          |                     |                                                       |                                                    |                  |                  |             |   |        |     |                                                                                             |         |
| 4.1                                                                              | Diesel engine and its components | Stamping and Painting                                                   | Major    | Visual, Shade & DFT | Random                                                | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | IR               | √           | 2 | 2      | 1   | # Seaworthy packing for export orders                                                       |         |
| 4.2                                                                              |                                  | Packing #                                                               | Major    | Visual              | 100%                                                  |                                                    |                  | Packing List     | √           | 2 | 2      | 1   |                                                                                             |         |

**Notes:-**

- This MQP should be read along with specification ((Latest revisions to be considered as per PO), approved drawings & approved datasheet.
- Specification/drawing/datasheet shall prevail over quality plan for contradiction if any.
- Any project/customer specific requirements which shall be notified have to be fulfilled by the vendor at the time of execution of order.

**Abbreviations:-**

|     |   |                           |     |   |                             |     |   |                    |
|-----|---|---------------------------|-----|---|-----------------------------|-----|---|--------------------|
| MTC | – | Material Test certificate | COC | – | Certificate of Compliance   | DFT | – | Dry Film Thickness |
| TC  | – | Test Certificate          | NDE | – | Non Destructive Examination | IR  | – | Inspection Report  |
| DFT | – | Dry Film Thickness        | IBR | – | Indian Boiler Regulations   | IS  | – | Indian Standards   |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL/BHEL's TPIA, 2 FOR VENDOR/SUB VENDOR & 3 FOR TSGENCO/TSGENCO's TPIA AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. \* FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-8         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                                                |                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <p style="text-align: center;"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1 style="text-align: center;">Annexure-8</h1> <h2 style="text-align: center;">Sub-vendor List</h2> |
|                                                                                                                                                                                                                                                                                |                                                                                                      |

|                                                   |                      |                     |                      |               |
|---------------------------------------------------|----------------------|---------------------|----------------------|---------------|
| <b>Revisions:</b><br>Refer to record of revisions | <b>Prepared by :</b> | <b>Checked by :</b> | <b>Approved by :</b> | <b>Date :</b> |
|                                                   | RATISH KUMAR         | GIRISH PALO         | SURYA SATYA NAGESH M | 10.03.20      |

**BTPS PESD additional vendor approval**

| Sl.no | Material Description | Vendor                                                     | Remarks        |
|-------|----------------------|------------------------------------------------------------|----------------|
| 6     | ERW Pipes            | FUTNANI STEELS PVT LTD., SECUNDERABAD, TELANGANA           | Approved       |
|       |                      | INDUS TUBES LIMITED, DELHI                                 | Approved       |
| 7     | Pipe Fittings        | U I PIPE FITTINGS PVT. LTD., HYDERABAD, TELANGANA          | Approved       |
|       |                      | TUBE PRODUCTS INCORPORATE, VADODARA, GUJARAT               | Approved       |
|       |                      | GUJARAT INFRAPIPES PVT.LTD., VADODARA, GUJARAT             | Approved       |
|       |                      | TRUE FORGE PVT.LTD., FARIDABAD, HARYANA                    | Approved       |
|       |                      | DEE DEVELOPMENT ENGINEERS LTD., FARIDABAD, HARYANA         | Approved       |
|       |                      | TRUE FAB ENGINEER (P) LTD., FARIDABAD, HARYANA             | Approved       |
|       |                      | P.K. TUBES & FITTINGS PVT. LTD., GURGOAN                   | Approved       |
|       |                      | K. S. PIPE FITTINGS PVT. LTD., TATARPUR, PALWAL, HARYANA   | Approved       |
|       |                      | TUBE TURN (INDIA) P. LTD., NAVI MUMBAI, MAHARASTRA         | Approved       |
| 8     | Flanges              | PRESHZINGER ENGINEERING, HYDERABAD, TELANGANA              | Approved       |
|       |                      | THE PUNJAB STEEL WORKS, NEW DELHI                          | Approved       |
|       |                      | METAL FORGINGS P. LTD., NEW DELHI                          | Approved       |
|       |                      | TUBE PRODUCTS INCORPORATE, VADODARA, GUJARAT               | Approved       |
|       |                      | C.D. INDUSTRIES, GHAZIABAD, UTTARPRADESH                   | Approved       |
|       |                      | CHW FORGE PRIVATE LIMITED, GHAZIABAD, UTTARPRADESH         | Approved       |
|       |                      | KISAAN STEELS (PVT) LTD., GHAZIABAD, UTTARPRADESH          | Approved       |
| 9     | Gate valves          | FOURESS ENGINEERING (I)PVT.LTD, HYDERABAD, TELANGANA       | Approved       |
|       |                      | L & T VALVES LIMITED, HYDERABAD, TELANGANA                 | Approved       |
|       |                      | FLOSTEER ENGINEERS PVT. LTD., AHMEDABAD, GUJARAT           | Approved       |
|       |                      | VALVITALIA S.P.A, ITALY                                    | Approved       |
|       |                      | B.F.E.SRL BONNEY FORGE, ITALY                              | Approved       |
|       |                      | WEIR BDK VALVES, HUBLI, KARNATAKA                          | Approved       |
|       |                      | NSSL LIMITED, NAGPUR, MAHARASTRA                           | Not Acceptable |
|       |                      | MICON VALVES (I) PVT. LTD., MUMBAI, MAHARASTRA             | Approved       |
|       |                      | NITON VALVE INDUSTRIES LTD, MUMBAI, MAHARASTRA             | Approved       |
|       |                      | SKILT FABRICATORS PVT.LTD,MUMBAI, MAHARASTRA               | Not Acceptable |
|       |                      | SHALIMAR VALVES PVT. LTD., NAVI MUMBAI, MAHARASTRA         | Not Acceptable |
|       |                      | STEEL STRONG VALVES (I) PVT. LTD., NAVI MUMBAI, MAHARASTRA | Approved       |
|       |                      | LEADER VALVES LIMITED, JALANDAR, PUNJAB                    | Approved       |
|       |                      | K.S.B PUMPS LTD., CHENNAI, TAMIL NADU                      | Approved       |



|    |                |                                                   |                |
|----|----------------|---------------------------------------------------|----------------|
| 14 | Control Cables | UNIVERSAL CABLES LTD, HYDERABAD, TELANGANA        | Approved       |
|    |                | THERMO CABLES LIMITED, HYDERABAD, TELANGANA       | Approved       |
|    |                | KEC INTERNATIONAL LIMITED, HYDERABAD, TELANGANA   | Not Acceptable |
|    |                | NICCO CORPORATION LTD HYD, HYDERABAD, TELANGANA   | Approved       |
|    |                | POLYCAB INDUSTRIES PVT.LTD., HYDERABAD, TELANGANA | Approved       |
|    |                | CORDS CABLE INDUSTRIES LTD., NEW DELHI            | Approved       |
|    |                | CMI LIMITED, NEW DELHI                            | Not Acceptable |
|    |                | KEI INDUSTRIES LIMITED, NEW DELHI                 | Approved       |
|    |                | DELTON CABLES LIMITED, NEW DELHI                  | Approved       |
|    |                | PARAMOUNT COMMUNICATIONS LTD, NEW DELHI           | Approved       |
|    |                | SPECIAL CABLES PVT. LTD., NEW DELHI               | Approved       |
|    |                | SRIRAM CABLES PVT. LTD., NEW DELHI                | Not Acceptable |
|    |                | GEMSCAB INDUSTRIES LTD., NEW DELHI                | Not Acceptable |
|    |                | SUYOG ELECTRICALS LTD, VADODARA, GUJARAT          | Not Acceptable |
|    |                | ELKAY TELELINKS LIMITED, FARIBADAB, HARYANA       | Approved       |
|    |                | RAVIN CABLES LTD, MUMBAI, MAHARASTRA              | Not Acceptable |
|    |                | ASSOCIATED CABLES PVT LTD., MUMBAI, MAHARASTRA    | Not Acceptable |
| 15 | Diesel Engine  | Greaves Cotton (R&H) - Pune                       | Approved       |
|    |                | Cummins- Kothrud / Viman Nagpur                   | Approved       |
|    |                | Caterpillar - USA                                 | Approved       |
|    |                | Ashok Leyland - Chennai (For booster Pump)        | Approved       |
|    |                | KOEL - Pune (For booster pump)                    | Approved       |

## Electrical vendor list-1

|   |                           |    |                                                   |              |
|---|---------------------------|----|---------------------------------------------------|--------------|
| 2 | BATTERY CHARGER           | 1  | AMAR RAJA POWER SYSTEMS, TIRUPATHI                | Approved     |
|   |                           | 2  | CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED        | Not Approved |
|   |                           | 3  | CHABBI ELECTRICALS, MUMBAI                        | Approved     |
|   |                           | 4  | EMERSON NETWORK POWER (PUNE) PVT.LTD., BANGALORE  | Approved     |
|   |                           | 5  | UNIVERSAL INSTRUMENTS MANUFACTURING Co. Pvt. Ltd. | Not Approved |
|   |                           | 6  | SERVILINK ENGINEERS PVT.LTD., VADODARA            | Not Approved |
|   |                           | 7  | DUBAS ENGG.PVT.LTD., BANGALORE                    | Not Approved |
|   |                           | 8  | Electronic Systems                                | Not Approved |
|   |                           | 9  | Power & Protection                                | Not Approved |
|   |                           | 10 | Statcon Power Controls Ltd.                       | Approved     |
|   |                           | 11 | SIGNOTRON (INDIA) PVT LTD.                        | Not Approved |
|   |                           | 12 | System Aid                                        | Not Approved |
|   |                           | 13 | SHERENE ELECTRO CONTROL PVT LTD                   | Not Approved |
| 3 | BATTERIES                 | 1  | AMAR RAJA BATTERIES, TIRUPATHI                    | Approved     |
|   |                           | 2  | HBL NIFE POWER SYSTEMS LTD.                       | Approved     |
|   |                           | 3  | EXIDE INDUSTRIES LIMITED                          | Approved     |
|   |                           | 4  | Grid power conversion Pvt Ltd.                    | Not Approved |
|   |                           | 5  | SIGNOTRON (INDIA) PVT LTD.                        | Not Approved |
|   |                           | 6  | System Aid                                        | Not Approved |
|   |                           | 7  | AMCO SAFT INDIA LTD.                              | Not Approved |
| 4 | DRAW OUT MCC (PANELS) *** | 1  | CROMPTON GREAVES LTD.                             | Not Approved |
|   |                           | 2  | C & S ELECTRIC LTD                                | Approved     |
|   |                           | 3  | GE INDIA INDUSTRIAL PRIVATE LIMITED               | Not Approved |
|   |                           | 4  | LARSEN & TOUBRO LIMITED                           | Approved     |
|   |                           | 5  | SIEMENS India Ltd.                                | Approved     |
|   |                           | 6  | BCH Electric Limited                              | Not Approved |
|   |                           | 7  | KMG ATOZ SYSTEMS (P) LTD.,                        | Not Approved |
|   |                           | 8  | Tricolite Electrical Industries, Sahibabad        | Not Approved |
|   |                           | 9  | SCHNEIDER ELECTRIC INDIA PVT.LTD.,                | Approved     |
|   |                           | 10 | Unilec Engineers Limited , New Delhi              | Not Approved |
|   |                           | 11 | VRL Automation Engineering & Projects Ltd         | Not Approved |
|   |                           | 12 | Pyrotech Electronics Pvt. Ltd., Unit - 4          | Not Approved |
|   |                           | 13 | CONTROL & SCHEMATICS LTD.,                        | Not Approved |
|   |                           | 14 | AMBIT SWITCHGEAR PVT LTD                          | Not Approved |
|   |                           | 15 | POWER CONTROL EQUIPMENTS                          | Not Approved |
|   |                           | 16 | CUBIC CONTROL SYSTEMS                             | Not Approved |
|   |                           | 17 | MEDITRON                                          | Not Approved |
|   |                           | 18 | SYSTEM INFOTECH                                   | Not Approved |
|   |                           | 19 | Nitya Electro Controls Pvt Ltd, Noida             | Approved     |



|   |                                                                   |   |                                       |              |
|---|-------------------------------------------------------------------|---|---------------------------------------|--------------|
| 7 | JB/ CT BOX/PUSH<br>BUTTON STATION /<br>CABLE<br>BOX/LCB/MLDB/SLDB | 1 | ELKTRISCHEN POWER GEARS (P) LTD.      | Not Approved |
|   |                                                                   | 2 | HI-POWER CONTROLS                     | Approved     |
|   |                                                                   | 3 | ORVEEM INDUSTRIES, BANGALORE          | Not Approved |
|   |                                                                   | 4 | VEE VEE CONTROLS PRIVATE LIMITED      | Not Approved |
|   |                                                                   | 5 | CYCLO ELECTRIC DEVICES & SERVICES CO. | Not Approved |
|   |                                                                   | 6 | SWITCHING CIRCUITS, KOLKATA           | Not Approved |
|   |                                                                   | 7 | SARVANNA SWITCHGEARS, BANGALORE       | Not Approved |
|   |                                                                   | 8 | PATNY SYSTEMS, HYDERABAD              | Not Approved |
|   |                                                                   | 9 | JASPER ENGINEERS PVT.LTD.             | Approved     |

*Signature*  
9/4/18

|  |  |    |                                           |              |
|--|--|----|-------------------------------------------|--------------|
|  |  | 10 | PRİYADARSHINI ENTERPRISES                 | Not Approved |
|  |  | 11 | prammen Industries                        | Not Approved |
|  |  | 12 | Dynaspede Integrated Systems Pvt. Ltd.,   | Not Approved |
|  |  | 13 | Power & Protection                        | Not Approved |
|  |  | 14 | Unilec Engineers Limited , New Delhi      | Not Approved |
|  |  | 15 | Hensel Electric India Pvt. Ltd.           | Not Approved |
|  |  | 16 | Shrenik & Company                         | Approved     |
|  |  | 17 | CONTROL DEVICES                           | Not Approved |
|  |  | 18 | JOLLY ENGINEERING INDUSTRIES,             | Not Approved |
|  |  | 19 | VRL Automation Engineering & Projects Ltd | Not Approved |
|  |  | 20 | Nitya Electro Controls Pvt Ltd, Noida     | Approved     |
|  |  | 21 | S.B. POWER SYSTEMS                        | Not Approved |
|  |  | 22 | Pyrotech Electronics Pvt. Ltd., Unit - 4  | Approved     |
|  |  | 23 | SAMCON INDUSTRIAL CONTROLS PVT LTD        | Not Approved |
|  |  | 24 | POWERTECH SWITCHGEARS (I) PVT LTD         | Not Approved |
|  |  | 25 | CUBIC CONTROL SYSTEMS                     | Not Approved |
|  |  | 26 | POSITRONICS PRIVATE LIMITED               | Not Approved |
|  |  | 27 | GEMCO CONTROLS LTD                        | Not Approved |
|  |  | 28 | HI-TECH SERVICES                          | Not Approved |

|   |              |    |                                      |              |
|---|--------------|----|--------------------------------------|--------------|
| 9 | LT AC MOTORS | 1  | JYOTI, VADODARA                      | Not Approved |
|   |              | 2  | BHARAT BIJLEE Limited., MUMBAI       | Approved     |
|   |              | 3  | ABB, FARIDABAD                       | Approved     |
|   |              | 4  | ALSTOM T&D INDIA LIMITED             | Not Approved |
|   |              | 5  | SIEMENS India Ltd.                   | Approved     |
|   |              | 6  | KIRLOSKAR ELECTRIC COMPANY LIMITED., | Approved     |
|   |              | 7  | WEG ELECTRIC ( INDIA ) PRIVATE LTD., | Not Approved |
|   |              | 8  | CROMPTON GREAVES LTD.                | Approved     |
|   |              | 9  | Triangle agencies & Sales Pvt Ltd ,  | Not Approved |
|   |              | 10 | Laxmi Hydraulics Pvt. Ltd.,          | Not Approved |

|    |                          |    |                                                                              |              |
|----|--------------------------|----|------------------------------------------------------------------------------|--------------|
| 12 | LT POWER & CONTROL CABLE | 1  | UNIVERSAL CABLES LIMITED                                                     | Approved     |
|    |                          | 2  | CRYSTAL CABLES, KOLKATA                                                      | Not Approved |
|    |                          | 3  | PLAZA CABLES, NEW DELHI                                                      | Not Approved |
|    |                          | 4  | RALLISON ELECTRICALS PVT. LTD. ( OLD NAME ROOLEX ELECTROPRODUCTS PVT. LTD.), | Not Approved |
|    |                          | 5  | NICCO CORPORATION LTD                                                        | Approved     |
|    |                          | 6  | TORRENT CABELS, THANE                                                        | Not Approved |
|    |                          | 7  | POLYCAB WIRES PVT LTD                                                        | Approved     |
|    |                          | 8  | DELTON CABLES, NEW DELHI                                                     | Approved     |
|    |                          | 9  | FINOLEX CABLES, MUMBAI                                                       | Not Approved |
|    |                          | 10 | BROOKS CABLES, MUMBAI                                                        | Not Approved |
|    |                          | 11 | SPECIAL CABLES PVT. LTD.                                                     | Not Approved |
|    |                          | 12 | RADIANT CABLES PVT LIMITED                                                   | Not Approved |
|    |                          | 13 | TOSHNIWAL CABLES, JAIPUR                                                     | Not Approved |
|    |                          | 14 | TCL CABLES LTD                                                               | Not Approved |
|    |                          | 15 | CORDS CABLE INDUSTRIES LTD.                                                  | Approved     |
|    |                          | 16 | HAVELL'S INDIA LTD., NEW DELHI                                               | Approved     |
|    |                          | 17 | SBEE CABLES LTD., BANGALORE                                                  | Not Approved |
|    |                          | 18 | KEI INDUSTRIES LIMITED                                                       | Approved     |
|    |                          | 19 | NATARAJ PLAST INDUSTRIES LTD., NEW DELHI                                     | Not Approved |
|    |                          | 20 | SUYOG ELECTRICALS LTD., BARODA                                               | Not Approved |
|    |                          | 21 | TECHMECH ENGINEERS , BANGALORE                                               | Not Approved |
|    |                          | 22 | GEMSCAB INDUSTRIES LTD                                                       | Approved     |
|    |                          | 23 | EPSILLON CABLES PVT. LTD                                                     | Not Approved |
|    |                          | 24 | INDO ASIAN FUSE GEAR LIMITED                                                 | Not Approved |
|    |                          | 25 | GOYOLENE FIBRES (INDIA) PVT LTD., DAMAN                                      | Not Approved |
|    |                          | 26 | TERACOM Limited                                                              | Not Approved |
|    |                          | 27 | Paramount Communications Ltd.                                                | Approved     |
|    |                          | 28 | Suraj Cables                                                                 | Not Approved |
|    |                          | 29 | Govind Cable Industries                                                      | Not Approved |
|    |                          | 30 | Shyam Cable Industries Delhi                                                 | Not Approved |
|    |                          | 31 | Mansfield Cable Co.                                                          | Not Approved |
|    |                          | 32 | KEC INTERNATIONAL LIMITED                                                    | Not Approved |
|    |                          | 33 | Nangalwala Impex (P) Ltd                                                     | Not Approved |
|    |                          | 34 | Windsor Cbles Pvt. Ltd.                                                      | Not Approved |

|    |                                                            |    |                                                |              |
|----|------------------------------------------------------------|----|------------------------------------------------|--------------|
|    |                                                            | 35 | ShivaPriya Cables Ltd.                         | Not Approved |
|    |                                                            | 36 | KRISHNA ELECTRICAL INDUSTRIES LTD              | Not Approved |
|    |                                                            | 37 | HINDUSTAN VIDYUT PRODUCTS LTD.                 | Not Approved |
|    |                                                            | 38 | Gupta Power Infrastructure Ltd                 | Not Approved |
|    |                                                            | 39 | CMI Limited                                    | Not Approved |
|    |                                                            | 40 | THERMO CABLES LIMITED                          | Not Approved |
|    |                                                            | 41 | DIAMOND POWER INFRASTRUCTURE LTD               | Not Approved |
|    |                                                            | 42 | RAVIN CABLES LIMITED                           | Not Approved |
|    |                                                            | 43 | VARSHA CABLES PVT LTD                          | Not Approved |
|    |                                                            | 44 | BHANSALI CABLES & CONDUCTORS PVT LTD           | Not Approved |
|    |                                                            | 45 | CABLE CORPORATION OF INDIA LTD,                | Not Approved |
|    |                                                            | 46 | Vikas Cable Company                            | Not Approved |
|    |                                                            | 47 | APAR INDUSTRIES LTD., ( Unit : Uniflex Cables) | Not Approved |
|    |                                                            | 48 | CHANDRESH CABLES LIMITED                       | Not Approved |
|    |                                                            | 49 | TC COMMUNICATION PVT LTD.,                     | Not Approved |
|    |                                                            | 50 | SPM POWER & TELECOM PVT LTD.,                  | Not Approved |
|    |                                                            | 51 | RR KABEL LIMITED                               | Not Approved |
|    |                                                            | 52 | MANOJ CABLES LTD.,                             | Not Approved |
|    |                                                            | 53 | ELKAY TELELINKS, NEW DELHI                     | Not Approved |
| 13 | HT XLPE CABLES                                             | 1  | UNIVERSAL CABLES LIMITED                       | Approved     |
|    |                                                            | 2  | TORRENT CABELS, THANE                          | Approved     |
|    |                                                            | 3  | NICCO CORPORATION LTD                          | Approved     |
|    |                                                            | 4  | POLYCAB WIRES PVT LTD                          | Approved     |
|    |                                                            | 5  | Paramount Communications Ltd.                  | Approved     |
|    |                                                            | 6  | TERACOM Limited                                | Not Approved |
|    |                                                            | 7  | Sri ram cables                                 | Not Approved |
|    |                                                            | 8  | KEC INTERNATIONAL LIMITED                      | Not Approved |
|    |                                                            | 9  | KEI Industries Ltd., Bangalore                 | Approved     |
|    |                                                            | 10 | KRISHNA ELECTRICAL INDUSTRIES LTD              | Not Approved |
|    |                                                            | 11 | HINDUSTAN VIDYUT PRODUCTS LTD.                 | Not Approved |
|    |                                                            | 12 | Gupta Power Infrastructure Ltd                 | Not Approved |
|    |                                                            | 13 | DIAMOND POWER INFRASTRUCTURE LTD               | Not Approved |
|    |                                                            | 14 | RAVIN CABLES LIMITED                           | Not Approved |
|    |                                                            | 15 | CABLE CORPORATION OF INDIA LTD,                | Approved     |
|    |                                                            | 16 | APAR INDUSTRIES LTD., ( Unit : Uniflex Cables) | Not Approved |
|    |                                                            | 17 | GEMSCAB INDUSTRIES LTD                         | Approved     |
| 14 | INSTRUMENT/SIGNAL/<br>SCREENED/TELEPHONE<br>SPECIAL CABLES | 1  | DELTON CABLES, NEW DELHI                       | Not Approved |
|    |                                                            | 2  | TOSHNIWAL CABLES, JAIPUR                       | Not Approved |
|    |                                                            | 3  | RELIANCE ENGG.                                 | Not Approved |
|    |                                                            | 4  | ELKAY TELELINKS, NEW DELHI                     | Not Approved |
|    |                                                            | 5  | UNIVERSAL CABLES LIMITED                       | Not Approved |
|    |                                                            | 6  | ASSOCIATED FLEXIBLES & WIRES, PUNE             | Not Approved |
|    |                                                            | 7  | BROOKS CABLES, MUMBAI                          | Not Approved |
|    |                                                            | 8  | SBEE CABLES LTD., BANGALORE                    | Not Approved |



|   |  |    |                                                                              |              |
|---|--|----|------------------------------------------------------------------------------|--------------|
| 3 |  | 9  | RALLISON ELECTRICALS PVT. LTD. ( OLD NAME ROOLEX ELECTROPRODUCTS PVT. LTD.), | Not Approved |
|   |  | 10 | THERMO CABLES LIMITED                                                        | Approved     |
|   |  | 11 | CORDS CABLE INDUSTRIES LTD.                                                  | Approved     |
|   |  | 12 | Thermo Cables Limited                                                        | Approved     |
|   |  | 13 | Govind Cable Industries                                                      | Not Approved |
|   |  | 14 | IMT Cables Private Ltd.,                                                     | Not Approved |
|   |  | 15 | Paras Wires Pvt Ltd                                                          | Not Approved |
|   |  | 16 | ShivaPriya Cables Ltd.                                                       | Not Approved |
|   |  | 17 | POLYCAB WIRES PVT LTD                                                        | Approved     |
|   |  | 18 | KEI INDUSTRIES LIMITED                                                       | Approved     |
|   |  | 19 | Advance Cable Technologies Pvt Ltd                                           | Approved     |
|   |  | 20 | Gupta Power Infrastructure Ltd                                               | Not Approved |
|   |  | 21 | CMI Limited                                                                  | Not Approved |
|   |  | 22 | THERMO CABLES LIMITED                                                        | Approved     |
|   |  | 23 | Nangalwala Impex (P) Ltd                                                     | Not Approved |
|   |  | 24 | Mansfield Cable Co.                                                          | Not Approved |
|   |  | 25 | LAPP INDIA (P) LTD                                                           | Not Approved |
|   |  | 26 | BHANSALI CABLES & CONDUCTORS PVT LTD                                         | Not Approved |
|   |  | 27 | APAR INDUSTRIES LTD., ( Unit : Uniflex Cables)                               | Not Approved |
|   |  | 28 | CHANDRESH CABLES LIMITED                                                     | Not Approved |
|   |  | 29 | Paramount Communications Ltd.                                                | Not Approved |
|   |  | 30 | TC COMMUNICATION PVT LTD.,                                                   | Approved     |
|   |  | 31 | RR KABEL LIMITED                                                             | Not Approved |
|   |  | 32 | SPECIAL CABLES PVT. LTD.                                                     | Not Approved |
|   |  | 33 | MANOJ CABLES LTD.,                                                           | Not Approved |

|    |                                           |   |                                         |              |
|----|-------------------------------------------|---|-----------------------------------------|--------------|
| 16 | CABLE GLANDS, LUGS, FERRULES, TYING WIRES | 1 | SUNIL & COMPANY                         | Not Approved |
|    |                                           | 2 | ELECTROMAC INDUSTRIES, MUMBAI           | Approved     |
|    |                                           | 3 | MAHAVEER ENGG. KOLKATA                  | Approved     |
|    |                                           | 4 | RAHUL BROTHERS, BANGALORE               | Not Approved |
|    |                                           | 5 | BLACK BURN & CO., KOLKATA               | Not Approved |
|    |                                           | 6 | BENGAL ELECTRICAL INDUSTRIES, KOLKATA   | Not Approved |
|    |                                           | 7 | BRACO ELECTRICALS (INDIA) PVT., LTD.,   | Approved     |
|    |                                           | 8 | LAPP INDIA (P) LTD                      | Approved     |
|    |                                           | 9 | LOTUS ELECTRICALS                       | Not Approved |
| 17 | HT/LT CABLE TERMINATION KIT               | 1 | SOUTH ELECTRIC CO., PVT LTD., BANGALORE | Not Approved |
|    |                                           | 2 | FRONTIER TECHNOLOGIES PVT.LTD.          | Not Approved |
|    |                                           | 3 | FRONTLINE ELECTRICALS, BANGALORE        | Not Approved |
|    |                                           | 4 | YAMUNA POWER & INFRASTRUCTURE LTD.      | Not Approved |
|    |                                           | 5 | HARI CONSOLIDATED PVT.LTD, NEW DELHI    | Not Approved |
|    |                                           | 6 | EVERSHINE ELECTRICALS                   | Not Approved |

|    |                    |    |                                           |              |
|----|--------------------|----|-------------------------------------------|--------------|
| 21 | EARTHING MATERIALS | 1  | SHIVA ENGG.WORKS, KOLKATA                 | Not Approved |
|    |                    | 2  | MAHAVEER ENGG. KOLKATA                    | Not Approved |
|    |                    | 3  | AARPEE ASSOCIATES, KOLKATA                | Not Approved |
|    |                    | 4  | VATCO ELEC-POWER PVT LTD.                 | Not Approved |
|    |                    | 5  | PATNY SYSTEMS, HYDERABAD                  | Not Approved |
|    |                    | 6  | SHREEM CAPACITORS PVT.LTD.                | Not Approved |
|    |                    | 7  | INDIA ELECTRICALS SYNDICATE,              | Not Approved |
|    |                    | 8  | RUKMANI ELECTRICAL & COMPONENTS PVT.LTD., | Approved     |
|    |                    | 9  | PREMIER POWER PRODUCTS PVT.LTD, KOLKATA   | Approved     |
|    |                    | 10 | Inar Profiles Pvt. Ltd.,                  | Not Approved |
|    |                    | 11 | Jamna Metal Company                       | Approved     |
|    |                    | 12 | UCIC PRIVATE LIMITED                      | Not Approved |
|    |                    | 13 | RABI ENGINEERING WORKS PVT LTD            | Not Approved |
|    |                    | 14 | R.S. VALVES & PRODUCTS                    | Not Approved |
|    |                    | 15 | INDUSTRIAL PERFORATION (INDIA) PVT. LTD.  | Not Approved |
|    |                    | 16 | RATAN PROJECTS & ENGINEERING CO PVT LTD   | Not Approved |
|    |                    | 17 | UNITECH FABRICATORS & ENGINEERS PVT LTD   | Not Approved |
| 22 | PLC / SCADA        | 1  | ROCKWELL AUTOMATION INDIA PVT., LTD.,     | Approved     |
|    |                    | 2  | GE INTELLIGENT PLATFORMS PVT LTD          | Approved     |

*Signature*  
9/4/15

|  |  |    |                                               |              |
|--|--|----|-----------------------------------------------|--------------|
|  |  | 3  | SIEMENS India Ltd.                            | Approved     |
|  |  | 4  | LARSEN & TOUBRO LIMITED                       | Not Approved |
|  |  | 5  | ABB LIMITED                                   | Not Approved |
|  |  | 6  | SCHNEIDER ELECTRIC INDIA PVT.LTD.             | Approved     |
|  |  | 7  | SYNERGY SYSTEMS & SOLUTIONS                   | Not Approved |
|  |  | 8  | YOKOGAWA INDIA LIMITED,                       | Not Approved |
|  |  | 9  | Megatech Controls Ltd.                        | Not Approved |
|  |  | 10 | Pyrotech Electronics Pvt. Ltd.                | Not Approved |
|  |  | 11 | HoneyWell Automation India Ltd.               | Approved     |
|  |  | 12 | I-Logicon Control Automation Pvt Ltd.         | Not Approved |
|  |  | 13 | AUTOMATION NETWORKS & SERVICES                | Not Approved |
|  |  | 14 | SUNLUX TECHNOLOGIES PRIVATE LIMITED           | Not Approved |
|  |  | 15 | EMCONS                                        | Not Approved |
|  |  | 16 | VASUNDRA AUTOMATION & ENGG.SERVICES PVT LTD., | Not Approved |
|  |  | 17 | POWERTECH SWITCHGEARS (I) PVT LTD             | Not Approved |
|  |  | 18 | GEMCO CONTROLS LTD                            | Not Approved |

|    |                  |    |                                             |              |
|----|------------------|----|---------------------------------------------|--------------|
| 28 | RTD/THERMOCOUPLE | 1  | NAGMAN SENSORS, CHENNAI                     | Not Approved |
|    |                  | 2  | ALTOP INDUSTRIES, VADODARA                  | Not Approved |
|    |                  | 3  | PYROTECH ELECTRONICS PVT. LTD.              | Approved     |
|    |                  | 4  | GENERAL INSTRUMENTS CONSORTIUM, BOMBAY      | Approved     |
|    |                  | 5  | BELLS CONTROLS LIMITED                      | Approved     |
|    |                  | 6  | WAREE INSTRUMENTS LIMITED,                  | Approved     |
|    |                  | 7  | Tempens Instruments (I) Pvt. Ltd.           | Not Approved |
|    |                  | 8  | Radix Electrosystems Pvt. Ltd.              | Not Approved |
|    |                  | 9  | Radix Sensors Pvt. Ltd.                     | Not Approved |
|    |                  | 10 | Toshniwal Industries Pvt. Ltd.              | Not Approved |
|    |                  | 11 | PROTOCONTROL INSTRUMENTS (I) PVT LTD        | Not Approved |
|    |                  | 12 | PYRO ELECTRIC INSTRUMENTS GOA PVT LTD       | Approved     |
|    |                  | 13 | WIKI INSTRUMENTS INDIA PVT LTD.,            | Approved     |
| 29 | PRESSURE GUAGES  | 1  | MANOMETER INDIA PVT LTD., THANE             | Approved     |
|    |                  | 2  | BELLS CONTROLS LIMITED                      | Approved     |
|    |                  | 3  | KROHNE MARSHALL PVT LTD., PUNE              | Not Approved |
|    |                  | 4  | A. N. INSTRUMENTS PRIVATE LIMITED           | Approved     |
|    |                  | 5  | GENERAL INSTRUMENT CONSORTIUM               | Approved     |
|    |                  | 6  | WAREE INSTRUMENTS LIMITED,                  | Approved     |
|    |                  | 7  | Hirlekar Precision Engg. Pvt. Ltd.          | Not Approved |
|    |                  | 8  | GOA INSTRUMENTS INDUSTRIES PVT LTD          | Approved     |
| 30 | HOOTER / HORN    | 9  | WIKI INSTRUMENTS INDIA PVT LTD.,            | Not Approved |
|    |                  | 1  | WAVES ELECTRONICS, COCHIN                   | Not Approved |
|    |                  | 2  | PROCON INSTRUMENTATION, CHENNAI             | Approved     |
|    |                  | 3  | KHERAJ ELECTRICALS INDIA PVT LTD, MUMBAI    | Not Approved |
|    |                  | 4  | Industrial Controls & Drives (I) Pvt. Ltd., | Approved     |

|    |                                                                                                      |    |                                                                                                                   |              |
|----|------------------------------------------------------------------------------------------------------|----|-------------------------------------------------------------------------------------------------------------------|--------------|
| 32 | ACTUATORS/TRANSMITTERS /Level / Flow / Pressure Switches/ Level Gauge / Magnetic / Radar Level Gauge | 1  | ROTORK CONTROLS (I) LTD., CHENNAI                                                                                 | Approved     |
|    |                                                                                                      | 2  | TOSHBRO CONTROLS (P) LIMITED.,                                                                                    | Not Approved |
|    |                                                                                                      | 3  | ENDRESS + HAUSER(INDIA ) PVT LTD                                                                                  | Approved     |
|    |                                                                                                      | 4  | SAAB TANK CONTROLS INDIA PVT LTD                                                                                  | Not Approved |
|    |                                                                                                      | 5  | SWITZER INSTRUMENTS LTD.                                                                                          | Approved     |
|    |                                                                                                      | 6  | S B E M PVT LTD.                                                                                                  | Not Approved |
|    |                                                                                                      | 7  | NIVO CONTROLS, INDORE                                                                                             | Not Approved |
|    |                                                                                                      | 8  | D.K.INSTRUMENTS PVT LTD.,                                                                                         | Not Approved |
|    |                                                                                                      | 9  | EMERSON PROCESS MANAGEMENT                                                                                        | Approved     |
|    |                                                                                                      | 10 | LEVCON CONTROLS PVT.LTD., KOLKATA                                                                                 | Approved     |
|    |                                                                                                      | 11 | HoneyWell Automation India Ltd.                                                                                   | Approved     |
|    |                                                                                                      | 12 | CHEMTROLS SAMIL INDIA PVT LTD                                                                                     | Approved     |
|    |                                                                                                      | 13 | VEGA INDIA LEVEL & PRESSURE MEASUREMENT PVT LTD                                                                   | Not Approved |
|    |                                                                                                      | 14 | Orbinox India Pvt Ltd                                                                                             | Not Approved |
|    |                                                                                                      | 15 | Shanghai Sailtor Automation Instrument Co., Ltd (Indian Representative : M/s Powertherm Engg Pvt Ltd., Hyderabad) | Not Approved |
|    |                                                                                                      | 16 | PROTOCONTROL INSTRUMENTS (I) PVT LTD                                                                              | Not Approved |
|    |                                                                                                      | 17 | SIEMENS India Ltd.                                                                                                | Approved     |



## AHP Mech

|    |                                              |   |                                                      |              |
|----|----------------------------------------------|---|------------------------------------------------------|--------------|
| 12 | Piping and valves                            |   |                                                      |              |
|    | a) MS Pipes - SW/ERW (Black and Galvanized)  | a | Sail                                                 | Approved     |
|    |                                              | b | Surya Roshni                                         | Not Approved |
|    |                                              | c | Welspun                                              | Approved     |
|    |                                              | d | ASIAN MILLS PRIVATE LIMITED                          | Approved     |
|    |                                              | e | JNB Steel Industries Pvt. Ltd.,                      | Not Approved |
|    |                                              | f | APL Apollo Tubes Ltd.,(Formerly Bihar Tubes Limited) | Not Approved |
|    |                                              | g | Jotindra Steel & Tubes Ltd.                          | Not Approved |
|    |                                              | h | Amardeep Steel Centre                                | Not Approved |
|    |                                              | i | JCO GAS PIPE LIMITED                                 | Not Approved |
|    |                                              | j | Tubes India                                          | Not Approved |
|    |                                              | k | M.J. Patel (India) Limited                           | Not Approved |
|    |                                              | l | ADS PRO - SHIELD                                     | Not Approved |
|    |                                              | m | RATNAMANI METALS & TUBES                             | Approved     |
|    | b) Pipe Fittings                             | a | TURBO ENGINEERS (CBE)                                | Not Approved |
|    |                                              | b | Enviro Bulk Handling Systems Pvt Ltd.                | Not Approved |
|    | c) Cast Basalt lined Pipes and Pipe Fittings | a | TURBO ENGINEERS (CBE)                                | Not Approved |
| 13 | Ball Valves                                  | a | Surya Valves                                         | Approved     |
|    |                                              | b | Hawa Engineers Ltd                                   | Approved     |
|    |                                              | c | A. V. VALVES LIMITED                                 | Approved     |
|    |                                              | d | DEMBLA VALVES LTD                                    | Approved     |
|    |                                              | e | MICON VALVES (INDIA)                                 | Approved     |
| 14 | GATE, GLOBE, CHECK Valves                    |   |                                                      |              |
|    | a) Cast Steel                                | a | AV Valves                                            | Approved     |
|    |                                              | b | ATAM Valves                                          | Approved     |
|    | b) Cast Iron                                 | a | AV Valves                                            | Approved     |
|    | c) Bronze                                    | a | AV Valves                                            | Approved     |

## Approved additional vendors for 1x800 MW KTPS B&W

|   |              |                                        |              |
|---|--------------|----------------------------------------|--------------|
| 9 | LT AC MOTORS | LAXMI HYDRAULIC PVT. LTD, Secunderabad | NOT APPROVED |
|   |              | SIEMENS INDIA LTD., Chennai            | APPROVED     |
|   |              | ABB LTD., Hyderabad                    | APPROVED     |

| CONTROL & INSTRUMENTATION ITEMS |                                                     |                                                       |          |
|---------------------------------|-----------------------------------------------------|-------------------------------------------------------|----------|
| 1                               | PRESSURE GAUGES                                     | FORBES MARSHALL (HYD) PVT LIMITED, Hyderabad          | APPROVED |
|                                 |                                                     | BAUMER TECHNOLOGIES, Mumbai                           | APPROVED |
|                                 |                                                     | GAUGES BOURDON INDIA, Navi Mumbai                     | APPROVED |
|                                 |                                                     | A.N. INSTRUMENTS PVT. LTD., Chennai                   | APPROVED |
| 2                               | DIFFERENTIAL PRESSURE INDICATOR / GAUGES            | BAUMER TECHNOLOGIES, Mumbai                           | APPROVED |
|                                 |                                                     | GAUGES BOURDON INDIA, Navi Mumbai                     | APPROVED |
|                                 |                                                     | SWITZER PROCESS INSTRUMENTS, Chennai                  | APPROVED |
| 3                               | PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES         | GAUGES BOURDON INDIA, Navi Mumbai                     | APPROVED |
| 4                               | PR. & DIFF. PR. TRANSMITTERS ( ELECTRONIC - SMART ) | EMERSON PROCESS MGT (I) PVT LTD, Secunderabad         | APPROVED |
|                                 |                                                     | ABB LIMITED, Hyderabad                                | APPROVED |
|                                 |                                                     | FUJI ELECTRIC SYSTEMS CO. LTD., ANDHERI (EAST) MUMBAI | APPROVED |
|                                 |                                                     | YOKOGAWA INDIA LIMITED, Bangalore                     | APPROVED |



|   |                                                        |                                                       |              |
|---|--------------------------------------------------------|-------------------------------------------------------|--------------|
| 6 | RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES) | GOA INSTRUMENTS INDUSTRIES                            | NOT APPROVED |
|   |                                                        | PYRO ELECTRIC INSTRUMENTS GOA, MAPUSA                 | APPROVED     |
|   |                                                        | TECHNO INSTRUMENTS, GANDHI NAGAR                      | NOT APPROVED |
|   |                                                        | BAUMER TECHNOLOGIES, ANDHERI EAST, MUMBAI             | APPROVED     |
|   |                                                        | THERMAL INSTRUMENT INDIA, DIST SINDHUDURG Maharashtra | NOT APPROVED |
|   |                                                        | TEMPSONS INSTRUMENTS (I) PVT.LTD., UDAIPUR            | NOT APPROVED |
|   |                                                        |                                                       |              |
| 7 | THERMOMETERS ( BIMETALLIC )                            | GOA INSTRUMENTS INDUSTRIES                            | APPROVED     |
|   |                                                        | ASHCROFT INDIA PVT. LTD.-Gujarat, GANDHINAGAR         | APPROVED     |
|   |                                                        | NUOVAFIMA SPA                                         | NOT APPROVED |
|   |                                                        | H.GURU INSTRUMENTS(S.I)PVT.LTD, Bangalore             | APPROVED     |
|   |                                                        | BAUMER TECHNOLOGIES, VAPI                             | APPROVED     |
|   |                                                        | GAUGES BOURDON INDIA, Navi Mumbai                     | APPROVED     |
| 8 | THERMOMETERS (GAS FILLED )                             | ASHCROFT INDIA PVT. LTD.-Gujarat                      | APPROVED     |
|   |                                                        | H.GURU INSTRUMENTS(S.I)PVT.LTD, Bangalore             | APPROVED     |
|   |                                                        | BAUMER TECHNOLOGIES, VAPI                             | APPROVED     |
|   |                                                        | GAUGES BOURDON INDIA, Navi Mumbai                     | APPROVED     |
| 9 | THERMOWELLS                                            | CARLO DYNATECH INDUSTRIES, Patancheru                 | NOT APPROVED |
|   |                                                        | GOA INSTRUMENTS INDUSTRIES, Goa                       | APPROVED     |
|   |                                                        | ASHCROFT INDIA PVT. LTD.-Gujarat                      | APPROVED     |
|   |                                                        | MICRO PRECISION PRODUCTS (P) LTD., Haryana            | NOT APPROVED |
|   |                                                        | H.GURU INSTRUMENTS(S.I)PVT.LTD, Bangalore             | APPROVED     |
|   |                                                        | PRECISION ENGINEERING INDS., Mumbai                   | APPROVED     |
|   |                                                        | THERMAL INSTRUMENT INDIA, Maharashtra                 | NOT APPROVED |
|   |                                                        | TOSHNIWAL INDUSTRIES PVT. LTD., Ajmer                 | APPROVED     |
|   |                                                        | INDUSTRIAL INSTRUMENTATION, Kolkata                   | APPROVED     |

|    |                  |                                                 |              |
|----|------------------|-------------------------------------------------|--------------|
| 16 | FOUNDATION BOLTS | A.V. Forgings Ropar Punjab                      | Not Approved |
|    |                  | Advance Steel Tubes Ltd Ghaziabad Uttar Pradesh | Not Approved |
|    |                  | Deepak Fastners Ltd Ludhiana Punjab             | Approved     |
|    |                  | M/s Arhant Industries Meerut Uttar Pradesh      | Not Approved |
|    |                  | N.L. ENGINEERS PVT. LTD. Punjab                 | Not Approved |
|    |                  | New Modern Technomech Pvt Ltd Mayurbhanj Orissa | Not Approved |
|    |                  | Nexo Industries Limited Ludhiana Punjab         | Not Approved |
|    |                  | VSP Enterprises Pvt. Ltd. Sonapat Haryana       | Not Approved |
| 17 | GI PIPE          | Advance Steel Tubes Ltd Ghaziabad U.P           | Approved     |
|    |                  | Good Luck Steel Tubes Ltd Bulandshahar U.P      | Approved     |
|    |                  | Hi-Tech Pipes Limited Sikandrabad Uttar Pradesh | Not Approved |
|    |                  | Metalman Industries Ltd Indore Madhya Pradesh   | Approved     |
|    |                  | Modern Tools & Electric Co Delhi                | Approved     |
|    |                  | Ravindra Tubes Limited Hissar Haryana           | Approved     |
|    |                  | Siddhartha Tubes Ltd Rajgarh Madhya Pradesh     | Approved     |
|    |                  | Surya Roshni Ltd Haryana                        | Approved     |
|    |                  | UTKARSH TUBES & PIPES LIMITED Kolkata           | Approved     |
|    |                  | Vishal Pipes Ltd. Sikandrabad Uttar Pradesh     | Approved     |

|    |                                                |                                                    |              |
|----|------------------------------------------------|----------------------------------------------------|--------------|
| 26 | STRUCTURE HARDWARE / EQUIPMENT FIXING HARDWARE | A.V. Forgings Ropar Punjab                         | Approved     |
|    |                                                | Asp Private Ltd Howrah West Bengal                 | Approved     |
|    |                                                | Deepak Fastners Ltd Ludhiana Punjab                | Approved     |
|    |                                                | Fitwell Fasteners Bhopal Madhya Pradesh            | Approved     |
|    |                                                | Forex Fastners Pvt. Ltd. Ludhiana Punjab           | Not Approved |
|    |                                                | Lakshmi Precision Screws Limited Rohtak Haryana    | Approved     |
|    |                                                | Arhant Industries Meerut Uttar Pradesh             | Not Approved |
|    |                                                | Turbo Industries Pvt. Ltd. Ludhiana Punjab         | Not Approved |
|    |                                                | New India Engineering Corporation Jaipur Rajasthan | Approved     |
|    |                                                | Nexo Industries Limited Ludhiana Punjab            | Approved     |
|    |                                                | Nishant Steel Industries Ludhiana Punjab           | Not Approved |
|    |                                                | Paramhari Engineers Nagpur Maharashtra             | Not Approved |
|    |                                                | Pioneer Nuts And Bolts Pvt. Ltd. Ludhiana Punjab   | Not Approved |
|    |                                                | Precision Auto Engineers Ludhiana Punjab           | Approved     |
|    |                                                | Remax (India) Ludhiana Punjab                      | Approved     |
|    |                                                | Techman (India) Chandigarh                         | Approved     |

|    |                          |   |                                    |                |              |
|----|--------------------------|---|------------------------------------|----------------|--------------|
| 43 | FLOW NOZZLES             | 1 | ENGINEERING SPECIALITIES PVT LTD., | India          | Not Approved |
| 16 | GAUGES:DP GAUGES         | 1 | A.N. INSTRUMENTS PVT. LIMITED,     | India          | Approved     |
|    |                          | 2 | GENERAL INSTRUMENTS CONSORTIUM     | India          | Approved     |
|    |                          | 3 | H GURU INSTRUMENTS(SIJ) P.LTD.,    | India          | Approved     |
|    |                          | 4 | SWITZER INSTRUMENT LTD.,           | India          | Approved     |
|    |                          | 5 | WIKI INSTRUMENTS INDIA PVT.LTD     | India          | Approved     |
| 17 | GAUGES:PRESSURE GAUGE    | 1 | BAUMER TECHNOLOGIES INDIA PVT.LTD, | India          | Approved     |
|    |                          | 2 | BUDENBERG GAUGE CO LTD.,           | United Kingdom | Approved     |
|    |                          | 3 | GENERAL INSTRUMENTS CONSORTIUM     | India          | Approved     |
|    |                          | 4 | MANOMETER (INDIA) PVT.LTD.,        | India          | Not Approved |
|    |                          | 5 | WIKI INSTRUMENTS INDIA PVT.LTD     | India          | Approved     |
| 18 | GAUGES:TEMPERATURE GAUGE | 1 | BAUMER TECHNOLOGIES INDIA PVT.LTD, | India          | Approved     |
|    |                          | 2 | GOA INSTRUMENT INDUSTRIES PVT LTD, | India          | Approved     |
|    |                          | 3 | H GURU INSTRUMENTS(SIJ) P.LTD.,    | India          | Approved     |
| 19 | LOCAL INSTRUMENT ENC     | 1 | SALAS ELECTRONICS                  |                |              |

|    |                      |   |                                     |       |              |
|----|----------------------|---|-------------------------------------|-------|--------------|
| 26 | MOTORS:L.T.MOTORS:WP | 1 | KIRLOSKAR ELECTRIC CO.LTD.          | India | Approved     |
|    |                      | 2 | LAXMI HYDRAULICS PVT.LTD.,          | India | Approved     |
|    |                      | 3 | MARATHON ELECTRIC MOTORS (INDIA) LT | India | Not Approved |
|    |                      | 4 | PRECISION ENGINEERING WORKS,        | India | Not Approved |

|    |                    |   |                                |       |          |
|----|--------------------|---|--------------------------------|-------|----------|
| 40 | PUMP:FUEL OIL PUMP | 4 | UNIVERSAL HOIST-O-FABRIK,      | India | Approved |
|    |                    | 1 | ALEKTON ENGG INDUSTRIES P.LTD. | India | Approved |
|    |                    | 2 | TUSHACO PUMPS PVT.LTD.,        | India | Approved |
|    |                    | 3 | U.T.PUMPS & SYSTEMS PVT. LTD., | India | Approved |

|                                              |              |     |                                               |              |
|----------------------------------------------|--------------|-----|-----------------------------------------------|--------------|
| 13                                           | CABLE GLANDS | 116 | AUTOMATION & GENERAL ELECTRIC CO., BHOPAL     | NOT APPROVED |
|                                              |              | 117 | COMET BRASS PRODUCTS, MUMBAI                  | APPROVED     |
|                                              |              | 118 | CENTRAL HARDWARE INDUSTRIES , BARODA(GUJRAT). | APPROVED     |
|                                              |              | 119 | FCG FLAMEPROOF CONTROL GEARS ,MUMBAI          | NOT APPROVED |
|                                              |              | 120 | FCG POWER INDUSTRIES P. LTD. , MUMBAI         | NOT APPROVED |
| R.E.JOINT, BF VALVES, MISC. TANK, FLASH TANK |              |     |                                               |              |

|   |                                                        |    |                                                                     |              |
|---|--------------------------------------------------------|----|---------------------------------------------------------------------|--------------|
| 7 | TEMPERATURE GAUGES / DIAL THERMOMETERS WITH THERMOWELL | 1  | B. C. TECHNOMATION PVT LTD, BHOPAL                                  | NOT APPROVED |
|   |                                                        | 2  | NEW SCIENTIFIC REPAIRS TRADING CO , KOLKATA                         | APPROVED     |
|   |                                                        | 3  | PRESSURE & TEMP. CONTROLS, KOLKATA                                  | APPROVED     |
|   |                                                        | 4  | A. N INSTRUMENTS PVT LTD, KOLKATA                                   | APPROVED     |
|   |                                                        | 5  | PROFESSIONAL MARKETING SERVICE, BHOPAL                              | NOT APPROVED |
|   |                                                        | 6  | GENERAL INSTRUMENTS CONSORTIUM, MUMBAI                              | APPROVED     |
|   |                                                        | 7  | SATURN ENGG. SERVICES, INDORE                                       | NOT APPROVED |
|   |                                                        | 8  | BAUMER TECHNOLOGIES INDIA PVT LTD, MUMBAI                           | APPROVED     |
|   |                                                        | 9  | LORDS ELECTIC CO., BHOPAL                                           | NOT APPROVED |
|   |                                                        | 10 | DETRIV INSTRUMENTATION & ELECTRONIC LTD, MUMBAI                     | APPROVED     |
| 8 | LIQUID LEVEL GAUGES                                    | 1  | LEVCON INSTRUMENTS PVT LTD, KOLKATA                                 | APPROVED     |
|   |                                                        | 2  | V. AUTOMAT & INSTRUMENTS PVT LTD INDIA, NEW DELHI                   | APPROVED     |
|   |                                                        | 3  | GENERAL INSTRUMENTS CONSORTIUM, MUMBAI                              | APPROVED     |
|   |                                                        | 4  | ASIAN INDUSTRIAL VALVES, CHENNAI                                    | NOT APPROVED |
|   |                                                        | 5  | PROFESSIONAL MARKETING SERVICE, BHOPAL                              | NOT APPROVED |
| 9 | VALVES (GATE, GLOBE, NEEDLE, ETC.)                     | 1  | LEADER VALVES LTD, JALANDHAR                                        | APPROVED     |
|   |                                                        | 2  | KRISHNA ENGG. CO. , BHOPAL                                          | NOT APPROVED |
|   |                                                        | 3  | BHEL, TIRUCHIRAPALLI                                                | APPROVED     |
|   |                                                        | 4  | NITON VALVES INDUSTRIES PVT LTD, MUMBAI                             | NOT APPROVED |
|   |                                                        | 5  | PROFESSIONAL MARKETING SERVICE, BHOPAL                              | NOT APPROVED |
|   |                                                        | 6  | LEVCON VALVES PVT LTD, KOLKATA                                      | APPROVED     |
|   |                                                        | 7  | FLOTEK INDUSTRIES                                                   | NOT APPROVED |
|   |                                                        | 8  | STEELSTRONG VALVES(I) PVT.LTD.                                      | NOT APPROVED |
|   |                                                        | 9  | PANDA TECHNOLOGIES INDIA PVT LTD, BHOPAL                            | APPROVED     |
|   |                                                        | 10 | WEIR BDK VALVES, A UNIT OF WEIR ENGG. SERVICES INDIA PVT LTD, HUBLI | APPROVED     |

## BHEL Trichy

|    |            |                            |       |          |
|----|------------|----------------------------|-------|----------|
| 24 | L.T.MOTORS | BHARAT BIJLEE LIMITED,     | India | Approved |
|    |            | CROMPTON GREAVES LIMITED,  | India | Approved |
|    |            | KIRLOSKAR ELECTRIC CO.LTD. | India | Approved |

## EDN BANGALORE

|    |                                                                                          |                                                                              |          |
|----|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------|
| 2  | 24 V DC thyristor based Battery Charger                                                  | M/s KELTRON POWER ELECTRONICS, TRIVENDRUM                                    | Approved |
|    |                                                                                          | M/s AMARARAJA POWER SYSTEMS LTD, TIRUPATI.                                   | Approved |
|    |                                                                                          | M/s CHLORIDE POWER SYSTEMS, KOLKATA                                          | Approved |
|    |                                                                                          | M/s CHHABI ELECTRICALS, JALGAON.                                             | Approved |
|    |                                                                                          | M/s HBL POWER SYSTEMS, HYDERABAD                                             | Approved |
| 3  | 24 V DC SMPS based Battery Charger                                                       | M/s AMARARAJA POWER SYSTEMS LTD, TIRUPATI.                                   | Approved |
|    |                                                                                          | M/s CHHABI ELECTRICALS, JALGAON.                                             | Approved |
|    |                                                                                          | M/s MASTECH, MUMBAI                                                          | Approved |
| 6  | Junction Box (FRP )                                                                      | M/s SHRENIK & COMPANY, AHMEDABAD                                             | Approved |
|    |                                                                                          | M/s FICOM ENGG. PVT. LTD, BANGALORE                                          | Approved |
|    |                                                                                          | M/s K.S. INSTRUMENTS, BANGALORE.                                             | Approved |
|    |                                                                                          | M/s MANISHA ENTERPRISES, PUNE                                                | Approved |
|    |                                                                                          | M/s SUCHITRA INDUSTRIES, BANGALORE.                                          | Approved |
| 7  | Junction Box (Metal)                                                                     | M/s PYROTECH, UDAIPUR                                                        | Approved |
|    |                                                                                          | M/s CHEMIN CONTROLS, PONIDCHERRY                                             | Approved |
|    |                                                                                          | M/s MANISHA ENTERPRISES, PUNE                                                | Approved |
| 8  | RTD - TT Junction Box (FRP)                                                              | M/s MANISHA ENTERPRISES, PUNE                                                | Approved |
| 9  | RTD - TT Junction Box (Metal)                                                            | M/s CHEMIN CONTROLS, PONIDCHERRY                                             | Approved |
| 10 | CJC Box / PDB for CJC Boxes                                                              | M/s CREATIVE INSTRUMENTS AND CONTROLS, BANGALORE                             | Approved |
| 11 | Junction Box (Die Cast Aluminium)                                                        | M/s MANISHA ENTERPRISES, PUNE                                                | Approved |
| 12 | Electronic Transmitter - Pr. / Diff. Pr.                                                 | M/s ABB, GERMANY/FARIDABAD                                                   | Approved |
|    |                                                                                          | M/s YOKOGAWA, JAPAN / BANGALORE                                              | Approved |
| 13 | Level Transmitter (Displacement type)                                                    | M/s DRESSER MASONIELAN, FRANCE. /                                            | Approved |
|    |                                                                                          | M/s ECKARDT, GERMANY                                                         | Approved |
| 14 | Level Transmitter (Ultrasonic type)                                                      | M/s ENDRESS+HAUSER, GERMANY/INDIA                                            | Approved |
| 15 | Level Transmitter (RADAR type)                                                           | M/s EMERSON PROCESS, USA / NAVI MUMBAI<br>( formerly FISHER ROSEMOUNT- USA ) | Approved |
|    |                                                                                          | M/s ABB, GERMANY/FARIDABAD                                                   | Approved |
|    |                                                                                          | M/s ENDRESS+HAUSER, GERMANY / INDIA                                          | Approved |
|    |                                                                                          | M/s YOKOGAWA, JAPAN / BANGALORE                                              | Approved |
| 16 | Field mounted (Dual Input) Temperature Transmitter                                       | M/s EMERSON PROCESS, USA / NAVI MUMBAI<br>( formerly FISHER ROSEMOUNT- USA ) | Approved |
|    |                                                                                          | M/s ENDRESS+HAUSER, GERMANY / INDIA                                          | Approved |
|    |                                                                                          | M/s YOKOGAWA, JAPAN / BANGALORE                                              | Approved |
|    |                                                                                          | M/s EMERSON PROCESS, USA / NAVI MUMBAI<br>( formerly FISHER ROSEMOUNT- USA ) | Approved |
| 17 | DIN-rail mounted Temperature Transmitter                                                 | M/s ENDRESS+HAUSER, GERMANY / INDIA                                          | Approved |
|    |                                                                                          | M/s ABB, GERMANY/FARIDABAD                                                   | Approved |
|    |                                                                                          | M/s ABB, GERMANY/FARIDABAD                                                   | Approved |
| 22 | Cable Glands                                                                             | M/s ELECTROMAC INDUSTRIES, MUMBAI                                            | Approved |
|    |                                                                                          | M/s BRACO ELECTRICALS, MUMBAI                                                | Approved |
| 23 | Cable Lugs                                                                               | M/s BRACO ELECTRICALS, MUMBAI                                                | Approved |
| 24 | Cable trays                                                                              | M/s JAMNA METAL COMPANY, NEW DELHI                                           | Approved |
| 25 | Instrumentation, Control & Compensating / Thermocouple extension cables (PVC, FRLS Type) | M/s CORDS CABLES, RAJASTHAN                                                  | Approved |
|    |                                                                                          | M/s DELTON CABLES, FARIDABAD                                                 | Approved |
|    |                                                                                          | M/s INCAB, PUNE                                                              | Approved |
|    |                                                                                          | M/s T C COMMUNICATION PVT. LTD, NEW DELHI                                    | Approved |
|    |                                                                                          | M/s POLYCAB, DAMAN                                                           | Approved |
| 26 | LT Power Cables (PVC/XLPE Insulation)                                                    | M/s THERMO CABLES, HYDERABAD                                                 | Approved |
|    |                                                                                          | M/s CORDS CABLES, RAJASTHAN                                                  | Approved |
|    |                                                                                          | M/s DELTON CABLES, FARIDABAD                                                 | Approved |
|    |                                                                                          | M/s KEI INDUSTRIES LTD, CHENNAI                                              | Approved |
|    |                                                                                          | M/s HAVELLS, NEW DELHI                                                       | Approved |
|    |                                                                                          | M/s PARAMOUNT CABLES, ALWAR                                                  | Approved |
|    |                                                                                          | M/s POLYCAB, DAMAN                                                           | Approved |
|    |                                                                                          | M/s THERMO CABLES, HYDERABAD                                                 | Approved |
|    |                                                                                          | M/s UNIVERSAL CABLES, SATNA                                                  | Approved |



|    |                      |                                                     |          |
|----|----------------------|-----------------------------------------------------|----------|
| 35 | Temperature Elements | M/s DETRIV INSTRUMENTATION AND ELETRI MUMBAI        | Approved |
|    |                      | M/s PYRO ELECTRIC INSTRUMENTS GOA PVT.L MAPUSA, GOA | Approved |
| 36 | Temperature Gauges   | M/s A.N.INSTRUMENTS PVT LTD CHENNAI                 | Approved |
|    |                      | M/s GENERAL INSTRUMENTS CONSORTIUM MUMBAI           | Approved |
|    |                      | M/s GOA THERMOSTATIC INSTRUMENTS GOA                | Approved |
|    |                      | M/s H.GURU INSTRUMENTS(SOUTH INDIA)PVT. BANGALORE   | Approved |
| 37 | Level Gauge          | LEVCON INSTRUMENTS P LTD KOLKATA                    | Approved |
|    |                      | SBEM PRIVATE LIMITED PUNE                           | Approved |
|    |                      | V.AUTOMAT & INSTRUMENTS PVT. LTD. NEW DELHI,        | Approved |
| 75 | INDICATING LAMPS     | ABB(I) LTD.                                         | Approved |
|    |                      | ESSEN & DEINIKI                                     | Approved |
|    |                      | GE POWER CONTROLS                                   | Approved |
|    |                      | SIEMENS                                             | Approved |
| 76 | MCB                  | SCHNEIDER ELECTRIC                                  | Approved |
|    |                      | SIEMENS AG / SIEMENS(I) LTD.                        | Approved |

## EPD

|    |                              |                       |          |
|----|------------------------------|-----------------------|----------|
| 12 | Thermal Overload Relay (OLR) | L & T                 | Approved |
|    |                              | GE-power              | Approved |
|    |                              | Siemens               | Approved |
|    |                              | C & S Electric        | Approved |
|    |                              | ABB                   | Approved |
|    |                              |                       |          |
| 13 | TimerI TIME DELAY RELAY      | L & T                 | Approved |
|    |                              | GE-power              | Approved |
|    |                              | Siemens               | Approved |
|    |                              | ABB                   | Approved |
|    |                              | HAVELLS               | Approved |
| 34 | Cable Gland                  | HEX                   | Approved |
|    |                              | Commet Brass Products | Approved |
|    |                              | DOWELLS               | Approved |
|    |                              | 3D                    | Approved |
|    |                              | Sunil & Co.           | Approved |
|    |                              |                       |          |
| 35 | Cable Lugs                   | Commet Brass Products | Approved |
|    |                              | DOWELLS               | Approved |
|    |                              | Baliga Lighting Eqpt. | Approved |

## KTPS Approved vendors of HPEP

|   |                          |                                |          |
|---|--------------------------|--------------------------------|----------|
| 3 | RESISTANCE TEMP.DETECTOR | PYRO ELECTRIC INSTRUMENTS GOA  | Approved |
|   |                          |                                |          |
|   |                          | DETRIV INSTRUMENTATION         | Approved |
|   |                          | GOA INSTRUMENTS INDUSTRIES     | Approved |
| 3 | IT.SD.102                | Connecting coupling (Membrane) |          |
|   |                          | EUROFLEX LTD, Hyderabad;       |          |
|   |                          | JOHN CRANE, UK;                |          |
|   |                          | RATHI TURBOFLEX                |          |
|   |                          | BIBBY TURBOFLEX.               | Approved |

## PEM vendor list of Kothagudem STPP

|   |                        |   |                                  |    |          |
|---|------------------------|---|----------------------------------|----|----------|
| 2 | DC LEAD ACID BATTERIES | 1 | EXIDE INDUSTRIES LTD             | NA | APPROVED |
|   |                        | 2 | HBL POWER SYSTEMS LTD            | NA | APPROVED |
|   |                        | 3 | HOPPECKE BATTERIEN GMBH & CO.KG, | NA | APPROVED |

## TBG

|                                           |                                                             |  |          |
|-------------------------------------------|-------------------------------------------------------------|--|----------|
| <b>BATTERY</b>                            | Amara Raja Power Systems Ltd.<br>Tirupathi Andhra Pradesh   |  | Approved |
|                                           | Exide Industries Ltd NEW Delhi                              |  | Approved |
|                                           | Hbl Power Systems Ltd<br>Hyderabad Andhra Pradesh           |  | Approved |
|                                           | Hoppecke Batterien GMBH & CO<br>KG                          |  | Approved |
|                                           | Exide Plante                                                |  | Approved |
| <b>BATTERY CHARGER</b>                    | Amara Raja Power Systems Ltd.<br>Tirupathi Andhra Pradesh   |  | Approved |
|                                           | Chhabi Electricals Pvt Ltd<br>Jalgaon Maharashtra [MSME]    |  | Approved |
|                                           | Hbl Power Systems Ltd<br>Hyderabad Andhra Pradesh           |  | Approved |
|                                           | Statcon Power Controls Limited<br>Hapur Uttar Pradesh(MSME) |  | Approved |
| <b>CABLE GLANDS &amp;<br/>ACCESSORIES</b> | Central Hardware Industries<br>Vadodara Gujarat             |  | Approved |
|                                           | Comet Brass Products Mumbai<br>Maharashtra                  |  | Approved |
|                                           | EX-Protecta Anand Gujarat                                   |  | Approved |

|                                              |                                                                            |                               |          |
|----------------------------------------------|----------------------------------------------------------------------------|-------------------------------|----------|
| <b>CABLE<br/>TERMINATION KIT</b>             | 3M Electro & Communication<br>India Pvt Ltd Pune Maharashtra               |                               | Approved |
|                                              | ABB Limited Faridabad Haryana                                              |                               | Approved |
|                                              | Raychem RPG (P) Limited<br>Panchmahal Gujarat                              |                               | Approved |
|                                              | Raychem RPG Private Limited<br>Thane Maharashtra                           |                               | Approved |
| <b>CAPACITOR<br/>VOLTAGE<br/>TRANSFORMER</b> | ABB India Limited Vadodara<br>Gujarat                                      |                               | Approved |
|                                              | Crompton Greaves Ltd Nashik<br>Maharashtra                                 |                               | Approved |
| <b>CIRCUIT BREAKER</b>                       | ABB India Limited Vadodara<br>Gujarat                                      |                               | Approved |
|                                              | Alstom T & D India Ltd.<br>Kanchipuram Tamil Nadu                          |                               | Approved |
|                                              | Siemens Ltd Aurangabad<br>Maharashtra                                      |                               | Approved |
| <b>CLAMPS &amp;<br/>CONNECTORS</b>           | Electromech & Transtech<br>Private Limited Kolkata West<br>Bengal          |                               | Approved |
|                                              | Klemmen Engineering<br>Corporation Chennai Tamil<br>Nadu [MSME]            |                               | Approved |
|                                              | Peevee Engineering Enterprises<br>Bangalore Karnataka [MSME]               |                               | Approved |
|                                              | Premier Power Products<br>(Calcutta) Pvt. Ltd. Chennai<br>Tamil Nadu       |                               | Approved |
|                                              | Rashtraudhyog Ltd Kolkata<br>West Bengal                                   |                               | Approved |
|                                              | Raychem RPG (P) Limited<br>Panchmahal Gujarat                              |                               | Approved |
|                                              | The Megha Engineering<br>Enterprises Industri Chennai<br>Tamil Nadu [MSME] |                               | Approved |
|                                              | Utsav Electro-Mech Pvt Ltd<br>Vadodara Gujarat                             |                               | Approved |
| <b>CONTROL PANELS &amp;<br/>METERS</b>       | ABB India Limited Bangalore<br>Karnataka                                   |                               | Approved |
|                                              | Secure Meters Ltd. Udaipur<br>Rajasthan                                    |                               | Approved |
|                                              |                                                                            | Siemens Limited Margaon Goa   | Approved |
|                                              |                                                                            | Siemens Ltd Thane Maharashtra | Approved |

|                         |                                                                    |                                    |          |
|-------------------------|--------------------------------------------------------------------|------------------------------------|----------|
| <b>FOUNDATION BOLTS</b> | Fitwell Fasteners Bhopal<br>Madhya Pradesh                         | bolts nuts<br>washers(flat spring) | Approved |
|                         | Forex Fastners Pvt. Ltd.<br>Ludhiana Punjab                        |                                    | Approved |
|                         | Precision Auto Engineers<br>Ludhiana Punjab                        |                                    | Approved |
|                         | Premier Power Products<br>(Calcutta) Pvt Ltd Howrah West<br>Bengal |                                    | Approved |
| <b>GI PIPE</b>          | Already given in BHEL-EDN LIST                                     |                                    | Approved |

|                     |                                                              |  |                                |
|---------------------|--------------------------------------------------------------|--|--------------------------------|
| <b>JUNCTION BOX</b> | C & S ELECTRIC LIMITED New<br>Delhi Delhi                    |  | Credentials to<br>be submitted |
|                     | Pyrotech Electronics Pvt Ltd<br>Udaipur Rajasthan            |  | Credentials to<br>be submitted |
|                     | Tenco Systems & Switchgears<br>Pvt Ltd Indore Madhya Pradesh |  | Credentials to<br>be submitted |

|                                       |                                                                    |                                                                      |          |
|---------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------|----------|
| <b>LT POWER and<br/>CONTROL CABLE</b> | Cords Cable Industries Ltd<br>Alwar Rajasthan                      | lt pvc(power and<br>control)                                         | Approved |
|                                       | Delton Cables Ltd. Faridabad<br>Haryana                            | SCREENED CABLE ,<br>HF CABLE                                         | Approved |
|                                       | Finecab Wires & Cables Pvt Ltd<br>Medak Andhra Pradesh <b>MSME</b> | lt pvc(power and<br>control)                                         | Approved |
|                                       | Gemscab Industries Limited<br>Alwar Rajasthan                      | HT XLPE Power cable<br>upto 33 kV                                    | Approved |
|                                       | Havells India Ltd Alwar<br>Rajasthan                               | LT PVC XLPE (power<br>and control) & HT<br>XLPE Cables(upto<br>33kV) | Approved |
|                                       | KEI Industries Ltd. Bhiwadi<br>Rajasthan                           | (lt ht pvc xlpe & ehv<br>upto 132 kV) power<br>and control           | Approved |
|                                       | Nicco Corporation Ltd 24<br>Pargana (N) West Bengal                | LT HT PVC XLPE<br>(POWER &<br>CONTROL)                               | Approved |
|                                       | Paramount Communications<br>Ltd. Rewari Haryana                    | HT Power cable(up<br>to 33kV)                                        | Approved |
|                                       | Polycab Wires Pvt Ltd Daman<br>Daman & Diu                         | LT HT PVC XLPE<br>(POWER &<br>CONTROL)                               | Approved |
|                                       | Universal Cables Ltd Satna<br>Madhya Pradesh                       | LT HT EHV PVC XLPE<br>(power & control)                              | Approved |



## Trichy Boughtout

|    |                      |                                  |       |          |
|----|----------------------|----------------------------------|-------|----------|
| 3  | LT-PVC CONTROL CABLE | CORDS CABLE INDUSTRIES LIMITED., | India | Approved |
|    |                      | DELTON CABLES LIMITED,           | India | Approved |
|    |                      | KEC INTERNATIONAL LIMITED,       | India | Approved |
|    |                      | KEI INDUSTRIES LIMITED,          | India | Approved |
|    |                      | POLYCAB WIRE PVT. LTD.,          | India | Approved |
| 4  | LT-XLPE POWER CABLE  | CORDS CABLE INDUSTRIES LIMITED., | India | Approved |
|    |                      | DELTON CABLES LIMITED,           | India | Approved |
|    |                      | KEI INDUSTRIES LIMITED           | India | Approved |
|    |                      | POLYCAB WIRE PVT. LTD.,          | India | Approved |
| 24 | LT.MOTORS            | BHARAT BIJLEE LIMITED,           | India | Approved |
|    |                      | CROMPTON GREAVES LIMITED,        | India | Approved |
|    |                      | KIRLOSKAR ELECTRIC CO.LTD.       | India | Approved |
| 27 | FRP JUNCTION BOX     | K.S.INSTRUMENTS PVT. LTD,        | India | Approved |
|    |                      | MANISHA COMPOSITEKS PVT LTD      | India | Approved |
|    |                      | SUCHITRA INDUSTRIES              | India | Approved |
| 11 | FUEL OIL PUMP        | ALEKTON ENGG.INDUSTRIES P.LTD.,  | India | Approved |
|    |                      | TUSHACO PUMPS PVT.LTD.,          | India | Approved |
|    |                      | U.T.PUMPS & SYSTEMS PVT. LTD.,   | India | Approved |

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-9         |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                                                |                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| <p style="text-align: center;"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1>Annexure-9</h1> <h2>Master DOC List Format</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

**Annexure-9A: MASTER DOCUMENT LIST - Hydrant / Spray Pump: Motor & Diesel Engine driven**

|                |                                                                                           |              |              |         |                    |                               |                                   |                        |                   |                           |    |         |
|----------------|-------------------------------------------------------------------------------------------|--------------|--------------|---------|--------------------|-------------------------------|-----------------------------------|------------------------|-------------------|---------------------------|----|---------|
|                | Vendor Name:                                                                              |              |              |         | PROJECT:           |                               |                                   |                        |                   |                           |    |         |
|                | Vendor Contact Person:                                                                    |              |              |         | BHEL PO No.        |                               | PO date:                          |                        |                   | PO Dly. Date:             |    |         |
|                | Vendor contact No.                                                                        |              |              |         | Supplier's Job No. |                               |                                   |                        |                   |                           |    |         |
|                | SYSTEM/PACKAGE:                                                                           | Hydrant Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20                         |                        |                   | Submission status to BHEL |    |         |
| Sl.No          | DRG/DOC. NAME                                                                             | DRG/DOC NO.  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission           | Count of DUE as on Dt. | STATUS            | Rev-0                     |    |         |
|                |                                                                                           |              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                       |                        | " * /PV/PB /PC/AA | SD                        | AD | APP.CAT |
| 1.0 Mechanical |                                                                                           |              |              |         |                    |                               |                                   |                        |                   |                           |    |         |
| A              | MECHANICAL                                                                                |              |              |         |                    |                               |                                   |                        |                   |                           |    |         |
| 1              | Pump Data Sheet -Engine & Motor Driven                                                    | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 2              | Pump Performance curve-Motor Driven                                                       | Later        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 3              | Pump Performance curve-Engine Driven                                                      | Later        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 4              | Pump & Motor assembly GA drawing                                                          | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 5              | Pump & Engine assembly GA drawing                                                         | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 6              | Pump Cross Sectional Drawing-Motor Driven                                                 | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 7              | Pump Cross Sectional Drawing-Engine Driven                                                | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 12             | T-S Curve                                                                                 | Later        |              | I       | N                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 13             | Diesel engine GA Drawing                                                                  | Later        |              | A       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 14             | Diesel engine Data Sheet                                                                  | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 15             | Control Panel GA Drawing & Wiring Diagram                                                 | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 16             | Diesel Engine Wiring Diagram                                                              | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 17             | Interconnection diagram between Diesel Engine, Control panel, Battery and battery charger | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 18             | Battery Charger Data Sheet                                                                | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 19             | Battery Data Sheet                                                                        | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 20             | Battery capacity calculation sheet                                                        | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 21             | Fuel tank Drawing                                                                         | Later        |              | A       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 22             | Fuel tank calculation sheet                                                               | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |

**Annexure-9A: MASTER DOCUMENT LIST - Hydrant / Spray Pump: Motor & Diesel Engine driven**

|       | Vendor Name:                                               |              |              |         | PROJECT:           |                               |                                    |                        |                   |                           |    |         |
|-------|------------------------------------------------------------|--------------|--------------|---------|--------------------|-------------------------------|------------------------------------|------------------------|-------------------|---------------------------|----|---------|
|       | Vendor Contact Person:                                     |              |              |         | BHEL PO No.        |                               | PO date:                           |                        |                   | PO Dly. Date:             |    |         |
|       | Vendor contact No.                                         |              |              |         | Supplier's Job No. |                               |                                    |                        |                   |                           |    |         |
|       | SYSTEM/PACKAGE:                                            | Hydrant Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20                          |                        |                   | Submission status to BHEL |    |         |
| Sl.No | DRG/DOC. NAME                                              | DRG/DOC NO.  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission            | Count of DUE as on Dt. | STATUS            | Rev-0                     |    |         |
|       |                                                            |              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                        |                        | " * /PV/PB /PC/AA | SD                        | AD | APP.CAT |
| 24    | Coupling GA Drawing for Motor Driven Pump                  | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 25    | Coupling GA Drawing for Engine Driven Pump                 | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 26    | Mechanical Seal GA Drawing and details: Motor driven Pump  | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 27    | Mechanical Seal GA Drawing and details: Engine driven Pump | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 8     | INSTRUMENTTAION                                            |              |              |         |                    |                               |                                    |                        |                   |                           |    |         |
| 1     | Data Sheet of Level Transmitter                            | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| 2     | Data Sheet of Level Gauge                                  | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| 3     | Datasheet of Pump Bearing RTDs                             | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| 4     | Datasheet of Pump Bearing TGs                              | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| 5     | Data Sheet of Junction Box                                 | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| 6     | GAD of Junction Box                                        | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| C     | MISCELLANEOUS                                              |              |              |         |                    |                               |                                    |                        |                   |                           |    |         |
| 1     | Performance Test Procedure: Motor driven & Engine Driven   | Later        |              | A       | Y                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 2     | NPSH test procedure                                        | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 3     | Vibration test procedure & Temperature rise test procedure | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 5     | Hydro Test Procedure                                       | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 6     | NDE Test Procedure                                         | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 8     | Painting proccedure                                        | Later        |              | A       | N                  | N                             | Within 10 weeks after PO placement |                        |                   |                           |    |         |
| 9     | Packing List                                               | Later        |              | I       | N                  | N                             | Before Despatch                    |                        |                   |                           |    |         |
| 10    | BILL OF MATERIAL                                           | Later        |              | A       | N                  | N                             | Within 10 weeks after PO placement |                        |                   |                           |    |         |

| Annexure-9A: MASTER DOCUMENT LIST - Hydrant / Spray Pump: Motor & Diesel Engine driven |                                                                                                        |                                      |              |         |                    |                               |                                                      |                        |                 |                                         |    |         |
|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------|--------------|---------|--------------------|-------------------------------|------------------------------------------------------|------------------------|-----------------|-----------------------------------------|----|---------|
|                                                                                        | Vendor Name:                                                                                           |                                      |              |         | PROJECT:           |                               |                                                      |                        |                 |                                         |    |         |
|                                                                                        | Vendor Contact Person:                                                                                 |                                      |              |         | BHEL PO No.        |                               | PO date:                                             |                        |                 | PO Dly. Date:                           |    |         |
|                                                                                        | Vendor contact No.                                                                                     |                                      |              |         | Supplier's Job No. |                               |                                                      |                        |                 |                                         |    |         |
|                                                                                        | SYSTEM/PACKAGE:                                                                                        | Hydrant Pump                         |              |         |                    | TODAY-DATE                    | 11-Mar-20                                            |                        |                 | Submission status to BHEL               |    |         |
| Sl.No                                                                                  | DRG/DOC. NAME                                                                                          | DRG/DOC NO.                          | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission                              | Count of DUE as on Dt. | STATUS          | Rev-0                                   |    |         |
|                                                                                        |                                                                                                        |                                      | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                                          |                        | " *PV/PB /PC/AA | SD                                      | AD | APP.CAT |
| 11                                                                                     | BILLING BREAKUP                                                                                        | Later                                |              | A       | N                  | N                             | Before Despatch                                      |                        |                 |                                         |    |         |
| 12                                                                                     | QUALITY ASSURANCE PLAN                                                                                 | Later                                |              | A       | N                  | Y                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 13                                                                                     | SUB VENDOR LIST                                                                                        | Later                                |              | I       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 14                                                                                     | COMMISSIONING SPARES LIST                                                                              | Later                                |              | A       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 15                                                                                     | Mandatory Spares List                                                                                  | Later                                |              | A       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 16                                                                                     | LUBE OIL SCHEDULE                                                                                      | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                 |                                         |    |         |
| 20                                                                                     | O& M Manuals(Soft Copies)                                                                              | Later                                |              | A       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                 |                                         |    |         |
| 21                                                                                     | O& M Manuals(Hard Copies)**<br>** hard copy shall be furnished after getting concurrence on soft copy. | Later                                |              | I       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                 |                                         |    |         |
|                                                                                        |                                                                                                        |                                      |              |         |                    |                               | TOTAL                                                | 0                      |                 | *APP.CAT                                |    |         |
|                                                                                        | A-Approval Category                                                                                    | PV-Commented and pending with vendor |              |         |                    |                               | TOTAL "PV"                                           |                        | 0               | A1-'Approved                            |    |         |
|                                                                                        | I-Information Category                                                                                 | PB- Pending with BHEL                |              |         |                    |                               | TOTAL "PB"                                           |                        | 0               | A2-'Mfg. Clearance given subject incorp |    |         |
|                                                                                        |                                                                                                        | PC- Pending with Customer            |              |         |                    |                               | TOTAL "PC"                                           |                        | 0               | A3-Commented.Revision & resubmission    |    |         |
|                                                                                        |                                                                                                        | AA- Approved                         |              |         |                    |                               | TOTAL "AA"                                           |                        | 0               | A4- Retained for info.                  |    |         |
|                                                                                        |                                                                                                        | OD-Overdue                           |              |         |                    |                               | TOTAL "OD"                                           |                        | 0               |                                         |    |         |
|                                                                                        |                                                                                                        | " " - Not yet Due.                   |              |         |                    |                               |                                                      |                        | 5               |                                         |    |         |

| Vendor documentation status |                |                               |                            |                             |                                       |                      |                               |                          |                 |
|-----------------------------|----------------|-------------------------------|----------------------------|-----------------------------|---------------------------------------|----------------------|-------------------------------|--------------------------|-----------------|
| Total No of Docs            | Due as on Date | Submitted by vendor as on Dt. | Approved by BHEL as on Dt. | Commented by BHEL as on Dt. | Pending with BHEL/CUSTOMER as on date | %age of Dos Approved | %age of critical Dos Approved | Is Mfg. Clearance given? | Status/ Remarks |

**Annexure-9A: MASTER DOCUMENT LIST - Hydrant / Spray Pump: Motor & Diesel Engine driven**

|       |                        |              |              |         |                    |                               |                         |                        |                          |               |                           |         |
|-------|------------------------|--------------|--------------|---------|--------------------|-------------------------------|-------------------------|------------------------|--------------------------|---------------|---------------------------|---------|
|       | Vendor Name:           |              |              |         | PROJECT:           |                               |                         |                        |                          |               |                           |         |
|       | Vendor Contact Person: |              |              |         | BHEL PO No.        |                               | PO date:                |                        |                          | PO Dly. Date: |                           |         |
|       | Vendor contact No.     |              |              |         | Supplier's Job No. |                               |                         |                        |                          |               |                           |         |
|       | SYSTEM/PACKAGE:        | Hydrant Pump |              |         |                    |                               | TODAY-DATE              | 11-Mar-20              |                          |               | Submission status to BHEL |         |
| Sl.No | DRG/DOC. NAME          | DRG/DOC NO.  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission | Count of DUE as on Dt. | STATUS                   | Rev-0         |                           |         |
|       |                        |              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy             |                        | " *P/PB /PC/AA           | SD            | AD                        | APP.CAT |
|       | (Nos)                  | (Nos)        | (Nos)        | (Nos)   | (Nos)              | (Nos)                         | % age                   | % age                  | (Y/N). / (If Y ) put Dt. |               |                           |         |
|       | 0                      | 0            | 0            | 0       | 0                  | 0                             | #DIV/0!                 | 0.00%                  | Y                        |               |                           |         |

**Annexure-9B/C: MASTER DOCUMENT LIST - Hydrant and Spray Booster Pump: Motor & Diesel Engine driven**

|                |                                                                                           |              |              |         |                    |                               |                                   |                        |                   |                           |    |         |
|----------------|-------------------------------------------------------------------------------------------|--------------|--------------|---------|--------------------|-------------------------------|-----------------------------------|------------------------|-------------------|---------------------------|----|---------|
|                | Vendor Name:                                                                              |              |              |         | PROJECT:           |                               |                                   |                        |                   |                           |    |         |
|                | Vendor Contact Person:                                                                    |              |              |         | BHEL PO No.        |                               | PO date:                          |                        |                   | PO Dly. Date:             |    |         |
|                | Vendor contact No.                                                                        |              |              |         | Supplier's Job No. |                               |                                   |                        |                   |                           |    |         |
|                | SYSTEM/PACKAGE:                                                                           | Hydrant Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20                         |                        |                   | Submission status to BHEL |    |         |
| Sl.No          | DRG/DOC. NAME                                                                             | DRG/DOC NO.  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission           | Count of DUE as on Dt. | STATUS            | Rev-0                     |    |         |
|                |                                                                                           |              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                       |                        | " * /PV/PB /PC/AA | SD                        | AD | APP.CAT |
| 1.0 Mechanical |                                                                                           |              |              |         |                    |                               |                                   |                        |                   |                           |    |         |
| A              | MECHANICAL                                                                                |              |              |         |                    |                               |                                   |                        |                   |                           |    |         |
| 1              | Pump Data Sheet -Engine & Motor Driven                                                    | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 2              | Pump Performance curve-Motor Driven                                                       | Later        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 3              | Pump Performance curve-Engine Driven                                                      | Later        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 4              | Pump & Motor assembly GA drawing                                                          | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 5              | Pump & Engine assembly GA drawing                                                         | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 6              | Pump Cross Sectional Drawing-Motor Driven                                                 | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 7              | Pump Cross Sectional Drawing-Engine Driven                                                | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 8              | Motor Data Sheet                                                                          | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 9              | Motor GA drawing                                                                          | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 10             | Motor TB drawing                                                                          | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 11             | Motor Curves                                                                              | Later        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 12             | T-S Curve                                                                                 | Later        |              | I       | N                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 13             | Diesel engine GA Drawing                                                                  | Later        |              | A       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 14             | Diesel engine Data Sheet                                                                  | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 15             | Control Panel GA Drawing & Wiring Diagram                                                 | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 16             | Diesel Engine Wiring Diagram                                                              | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 17             | Interconnection diagram between Diesel Engine, Control panel, Battery and battery charger | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |
| 18             | Battery Charger Data Sheet                                                                | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                   |                           |    |         |

**Annexure-9B/C: MASTER DOCUMENT LIST - Hydrant and Spray Booster Pump: Motor & Diesel Engine driven**

|       | Vendor Name:                                               |              |              |         | PROJECT:           |                               |                                    |                        |                   |                           |    |         |
|-------|------------------------------------------------------------|--------------|--------------|---------|--------------------|-------------------------------|------------------------------------|------------------------|-------------------|---------------------------|----|---------|
|       | Vendor Contact Person:                                     |              |              |         | BHEL PO No.        |                               | PO date:                           |                        |                   | PO Dly. Date:             |    |         |
|       | Vendor contact No.                                         |              |              |         | Supplier's Job No. |                               |                                    |                        |                   |                           |    |         |
|       | SYSTEM/PACKAGE:                                            | Hydrant Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20                          |                        |                   | Submission status to BHEL |    |         |
| Sl.No | DRG/DOC. NAME                                              | DRG/DOC NO.  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission            | Count of DUE as on Dt. | STATUS            | Rev-0                     |    |         |
|       |                                                            |              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                        |                        | " * /PV/PB /PC/AA | SD                        | AD | APP.CAT |
| 19    | Battery Data Sheet                                         | Later        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 20    | Battery capacity calculation sheet                         | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 21    | Fuel tank Drawing                                          | Later        |              | A       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 22    | Fuel tank calculation sheet                                | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 23    | P&ID/Schematic of Diesel Engine                            | Later        |              | I       | N                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 24    | Coupling GA Drawing for Motor Driven Pump                  | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 25    | Coupling GA Drawing for Engine Driven Pump                 | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 26    | Mechanical Seal GA Drawing and details: Motor driven Pump  | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| 27    | Mechanical Seal GA Drawing and details: Engine driven Pump | Later        |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                   |                           |    |         |
| B     | INSTRUMENTAION                                             |              |              |         |                    |                               |                                    |                        |                   |                           |    |         |
| 1     | Data Sheet of Level Transmitter                            | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| 1     | Data Sheet of Level Gauge                                  | Later        |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                   |                           |    |         |
| C     | MISCELLANEOUS                                              |              |              |         |                    |                               |                                    |                        |                   |                           |    |         |
| 1     | Performance Test Procedure: Motor driven & Engine Driven   | Later        |              | A       | Y                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 2     | NPSH test procedure                                        | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 3     | Vibration test procedure & Temperature rise test procedure | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 5     | Hydro Test Procedure                                       | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 6     | NDE Test Procedure                                         | Later        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                   |                           |    |         |
| 8     | Painting proccedure                                        | Later        |              | A       | N                  | N                             | Within 10 weeks after PO placement |                        |                   |                           |    |         |
| 9     | Packing List                                               | Later        |              | I       | N                  | N                             | Before Despatch                    |                        |                   |                           |    |         |



**Annexure-9B/C: MASTER DOCUMENT LIST - Hydrant and Spray Booster Pump: Motor & Diesel Engine driven**

|       | Vendor Name:                                                                                           |                                      |              |         | PROJECT:           |                               |                                                      |                        |                   |                                         |    |         |
|-------|--------------------------------------------------------------------------------------------------------|--------------------------------------|--------------|---------|--------------------|-------------------------------|------------------------------------------------------|------------------------|-------------------|-----------------------------------------|----|---------|
|       | Vendor Contact Person:                                                                                 |                                      |              |         | BHEL PO No.        |                               | PO date:                                             |                        |                   | PO Dly. Date:                           |    |         |
|       | Vendor contact No.                                                                                     |                                      |              |         | Supplier's Job No. |                               |                                                      |                        |                   |                                         |    |         |
|       | SYSTEM/PACKAGE:                                                                                        | Hydrant Pump                         |              |         |                    | TODAY-DATE                    | 11-Mar-20                                            |                        |                   | Submission status to BHEL               |    |         |
| Sl.No | DRG/DOC. NAME                                                                                          | DRG/DOC NO.                          | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission                              | Count of DUE as on Dt. | STATUS            | Rev-0                                   |    |         |
|       |                                                                                                        |                                      | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                                          |                        | " * /PV/PB /PC/AA | SD                                      | AD | APP.CAT |
| 10    | BILL OF MATERIAL                                                                                       | Later                                |              | A       | N                  | N                             | Within 10 weeks after PO placement                   |                        |                   |                                         |    |         |
| 11    | BILLING BREAKUP                                                                                        | Later                                |              | A       | N                  | N                             | Before Despatch                                      |                        |                   |                                         |    |         |
| 12    | QUALITY ASSURANCE PLAN                                                                                 | Later                                |              | A       | N                  | Y                             | Within 4 weeks after PO placement                    |                        |                   |                                         |    |         |
| 13    | SUB VENDOR LIST                                                                                        | Later                                |              | I       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                   |                                         |    |         |
| 14    | COMMISSIONING SPARES LIST                                                                              | Later                                |              | A       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                   |                                         |    |         |
| 15    | Mandatory Spares List                                                                                  | Later                                |              | A       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                   |                                         |    |         |
| 16    | LUBE OIL SCHEDULE                                                                                      | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                   |                                         |    |         |
| 20    | O& M Manuals(Soft Copies)                                                                              | Later                                |              | A       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                   |                                         |    |         |
| 21    | O& M Manuals(Hard Copies)**<br>** hard copy shall be furnished after getting concurrence on soft copy. | Later                                |              | I       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                   |                                         |    |         |
|       |                                                                                                        |                                      |              |         |                    |                               | TOTAL                                                | 0                      |                   | *APP.CAT                                |    |         |
|       | A-Approval Category                                                                                    | PV-Commented and pending with vendor |              |         |                    |                               | TOTAL "PV"                                           |                        | 0                 | A1-'Approved                            |    |         |
|       | I-Information Category                                                                                 | PB- Pending with BHEL                |              |         |                    |                               | TOTAL "PB"                                           |                        | 0                 | A2-'Mfg. Clearance given subject incorp |    |         |
|       |                                                                                                        | PC- Pending with Customer            |              |         |                    |                               | TOTAL "PC"                                           |                        | 0                 | A3-Commented.Revision & resubmission    |    |         |
|       |                                                                                                        | AA- Approved                         |              |         |                    |                               | TOTAL "AA"                                           |                        | 0                 | A4- Retained for info.                  |    |         |
|       |                                                                                                        | OD-Overdue                           |              |         |                    |                               | TOTAL "OD"                                           |                        | 0                 |                                         |    |         |
|       |                                                                                                        | " " - Not yet Due.                   |              |         |                    |                               |                                                      |                        | 5                 |                                         |    |         |

Vendor documentation status

**Annexure-9B/C: MASTER DOCUMENT LIST - Hydrant and Spray Booster Pump: Motor & Diesel Engine driven**

|       |                        |                |                               |                            |                             |                                       |                         |                               |                          |                |                           |         |
|-------|------------------------|----------------|-------------------------------|----------------------------|-----------------------------|---------------------------------------|-------------------------|-------------------------------|--------------------------|----------------|---------------------------|---------|
|       | Vendor Name:           |                |                               |                            | PROJECT:                    |                                       |                         |                               |                          |                |                           |         |
|       | Vendor Contact Person: |                |                               |                            | BHEL PO No.                 |                                       | PO date:                |                               |                          | PO Dly. Date:  |                           |         |
|       | Vendor contact No.     |                |                               |                            | Supplier's Job No.          |                                       |                         |                               |                          |                |                           |         |
|       | SYSTEM/PACKAGE:        | Hydrant Pump   |                               |                            |                             |                                       | TODAY-DATE              | 11-Mar-20                     |                          |                | Submission status to BHEL |         |
| Sl.No | DRG/DOC. NAME          | DRG/DOC NO.    | NO. OF SHTS.                  | CAT                        | CRITICAL FOR MFG?           | REQD.FOR CUSTOMER SUBMISSION?         | Plan date of submission | Count of DUE as on Dt.        | STATUS                   | Rev-0          |                           |         |
|       |                        |                | NO.                           | (A / I)                    | (Y/N)                       | (Y/N)                                 | dd-mmm-yyyy             |                               | " *PV/PB /PC/AA          | SD             | AD                        | APP.CAT |
|       | Total No of Docs       | Due as on Date | Submitted by vendor as on Dt. | Approved by BHEL as on Dt. | Commented by BHEL as on Dt. | Pending with BHEL/CUSTOMER as on date | %age of Dos Approved    | %age of critical Dos Approved | Is Mfg. Clearance given? | Status/Remarks |                           |         |
|       | (Nos)                  | (Nos)          | (Nos)                         | (Nos)                      | (Nos)                       | (Nos)                                 | % age                   | % age                         | (Y/N)./( If Y ) put Dt.  |                |                           |         |
|       | 0                      | 0              | 0                             | 0                          | 0                           | 0                                     | #DIV/0!                 | 0.00%                         | Y                        |                |                           |         |

**Annexure-9D: MASTER DOCUMENT LIST - Jockey pump**

|                | Vendor Name:                              |                              |              |         | PROJECT:           |                               |                                   |                        |                 |                           |    |         |
|----------------|-------------------------------------------|------------------------------|--------------|---------|--------------------|-------------------------------|-----------------------------------|------------------------|-----------------|---------------------------|----|---------|
|                | Vendor Contact Person:                    |                              |              |         | BHEL PO No.        |                               | PO date:                          |                        |                 | PO Dly. Date:             |    |         |
|                | Vendor contact No.                        |                              |              |         | Supplier's Job No. |                               |                                   |                        |                 |                           |    |         |
|                | SYSTEM/PACKAGE:                           | Condenser Cooling Water Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20                         |                        |                 | Submission status to BHEL |    |         |
| Sl.No          | DRG/DOC. NAME                             | DRG/DOC NO.                  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission           | Count of DUE as on Dt. | STATUS          | Rev-0                     |    |         |
|                |                                           |                              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                       |                        | " /PV/PB /PC/AA | SD                        | AD | APP.CAT |
| 1.0 Mechanical |                                           |                              |              |         |                    |                               |                                   |                        |                 |                           |    |         |
| A              | MECHANICAL                                |                              |              |         |                    |                               |                                   |                        |                 |                           |    |         |
| 1              | Pump Data Sheet                           | Later                        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 2              | Pump Performance curve-Motor Driven       | Later                        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 3              | Pump & Motor assembly GA drawing          | Later                        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 4              | Pump Cross Sectional Drawing              | Later                        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 5              | Motor Data Sheet                          | Later                        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 6              | Motor GA drawing                          | Later                        |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 7              | Motor Curves                              | Later                        |              | I       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 8              | T-S Curve                                 | Later                        |              | I       | N                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 9              | Coupling GA Drawing for Motor Driven Pump | Later                        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 10             | Mechanical Seal GA Drawing and details    | Later                        |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| B              | INSTRUMENTATION                           |                              |              |         |                    |                               |                                   |                        |                 |                           |    |         |
| C              | MISCELLANEOUS                             |                              |              |         |                    |                               |                                   |                        |                 |                           |    |         |
| 1              | Performance Test Procedure                | Later                        |              | A       | Y                  | N                             | Within 8 weeks after PO placement |                        |                 |                           |    |         |
| 2              | NPSH test procedure                       | Later                        |              | I       | N                  | N                             | Within 8 weeks after PO placement |                        |                 |                           |    |         |
| 3              | Vibration test procedure                  | Later                        |              | I       | N                  | N                             | Within 8 weeks after PO placement |                        |                 |                           |    |         |

**Annexure-9D: MASTER DOCUMENT LIST - Jockey pump**

|       |                                               |                              |              |         |                    |                               |                                    |                        |                 |                           |    |         |
|-------|-----------------------------------------------|------------------------------|--------------|---------|--------------------|-------------------------------|------------------------------------|------------------------|-----------------|---------------------------|----|---------|
|       | Vendor Name:                                  |                              |              |         | PROJECT:           |                               |                                    |                        |                 |                           |    |         |
|       | Vendor Contact Person:                        |                              |              |         | BHEL PO No.        |                               | PO date:                           |                        |                 | PO Dly. Date:             |    |         |
|       | Vendor contact No.                            |                              |              |         | Supplier's Job No. |                               |                                    |                        |                 |                           |    |         |
|       | SYSTEM/PACKAGE:                               | Condenser Cooling Water Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20                          |                        |                 | Submission status to BHEL |    |         |
| Sl.No | DRG/DOC. NAME                                 | DRG/DOC NO.                  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission            | Count of DUE as on Dt. | STATUS          | Rev-0                     |    |         |
|       |                                               |                              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                        |                        | " /PV/PB /PC/AA | SD                        | AD | APP.CAT |
| 4     | Temperature rise test procedure               | Later                        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 5     | Hydro Test Procedure                          | Later                        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 6     | NDE Test Procedure                            | Later                        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 7     | Balancing_LP test & ultrasonic test procedure | Later                        |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 8     | Painting proccedure                           | Later                        |              | A       | N                  | N                             | Within 10 weeks after PO placement |                        |                 |                           |    |         |
| 9     | Packing List                                  | Later                        |              | I       | N                  | N                             | Before Despatch                    |                        |                 |                           |    |         |

**Annexure-9D: MASTER DOCUMENT LIST - Jockey pump**

|       |                                                                                                        |                                      |              |         |                    |                               |                                                      |                        |                 |                                         |    |         |
|-------|--------------------------------------------------------------------------------------------------------|--------------------------------------|--------------|---------|--------------------|-------------------------------|------------------------------------------------------|------------------------|-----------------|-----------------------------------------|----|---------|
|       | Vendor Name:                                                                                           |                                      |              |         | PROJECT:           |                               |                                                      |                        |                 |                                         |    |         |
|       | Vendor Contact Person:                                                                                 |                                      |              |         | BHEL PO No.        |                               | PO date:                                             |                        |                 | PO Dly. Date:                           |    |         |
|       | Vendor contact No.                                                                                     |                                      |              |         | Supplier's Job No. |                               |                                                      |                        |                 |                                         |    |         |
|       | SYSTEM/PACKAGE:                                                                                        | Condenser Cooling Water Pump         |              |         |                    | TODAY-DATE                    | 11-Mar-20                                            |                        |                 | Submission status to BHEL               |    |         |
| Sl.No | DRG/DOC. NAME                                                                                          | DRG/DOC NO.                          | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission                              | Count of DUE as on Dt. | STATUS          | Rev-0                                   |    |         |
|       |                                                                                                        |                                      | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy                                          |                        | " /PV/PB /PC/AA | SD                                      | AD | APP.CAT |
| 10    | BILL OF MATERIAL                                                                                       | Later                                |              | A       | N                  | N                             | Within 10 weeks after PO placement                   |                        |                 |                                         |    |         |
| 11    | BILLING BREAKUP                                                                                        | Later                                |              | A       | N                  | N                             | Before Despatch                                      |                        |                 |                                         |    |         |
| 12    | QUALITY ASSURANCE PLAN                                                                                 | Later                                |              | A       | N                  | Y                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 13    | SUB VENDOR LIST                                                                                        | Later                                |              | I       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 14    | COMMISSIONING SPARES LIST                                                                              | Later                                |              | A       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 15    | Mandatory Spares List                                                                                  | Later                                |              | A       | N                  | N                             | Within 4 weeks after PO placement                    |                        |                 |                                         |    |         |
| 16    | LUBE OIL SCHEDULE                                                                                      | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                 |                                         |    |         |
| 17    | STARTUP PROCEDURE                                                                                      | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                 |                                         |    |         |
| 18    | ERECTION PROCEDURE & Commissioning procedure                                                           | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                 |                                         |    |         |
| 19    | INSPECTION/TESTS REPORTS/CERTIFICATE                                                                   | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                 |                                         |    |         |
| 20    | O& M Manuals(Soft Copies)                                                                              | Later                                |              | A       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                 |                                         |    |         |
| 21    | O& M Manuals(Hard Copies)**<br>** hard copy shall be furnished after getting concurrence on soft copy. | Later                                |              | I       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                 |                                         |    |         |
|       |                                                                                                        |                                      |              |         |                    |                               | TOTAL                                                | 0                      |                 | ^APP.CAT                                |    |         |
|       | A-Approval Category                                                                                    | PV-Commented and pending with vendor |              |         |                    |                               | TOTAL "PV"                                           |                        | 0               | A1-'Approved                            |    |         |
|       | I-Information Category                                                                                 | PB- Pending with BHEL                |              |         |                    |                               | TOTAL "PB"                                           |                        | 0               | A2-'Mfg. Clearance given subject incorp |    |         |
|       |                                                                                                        | PC- Pending with Customer            |              |         |                    |                               | TOTAL "PC"                                           |                        | 0               | A3-Commented.Revision & resubmissio     |    |         |
|       |                                                                                                        | AA- Approved                         |              |         |                    |                               | TOTAL "AA"                                           |                        | 0               | A4- Retained for info.                  |    |         |

**Annexure-9D: MASTER DOCUMENT LIST - Jockey pump**

|       |                        |                              |              |         |                    |                               |                         |                        |                 |                           |    |         |
|-------|------------------------|------------------------------|--------------|---------|--------------------|-------------------------------|-------------------------|------------------------|-----------------|---------------------------|----|---------|
|       | Vendor Name:           |                              |              |         | PROJECT:           |                               |                         |                        |                 |                           |    |         |
|       | Vendor Contact Person: |                              |              |         | BHEL PO No.        |                               | PO date:                |                        |                 | PO Dly. Date:             |    |         |
|       | Vendor contact No.     |                              |              |         | Supplier's Job No. |                               |                         |                        |                 |                           |    |         |
|       | SYSTEM/PACKAGE:        | Condenser Cooling Water Pump |              |         |                    | TODAY-DATE                    | 11-Mar-20               |                        |                 | Submission status to BHEL |    |         |
| Sl.No | DRG/DOC. NAME          | DRG/DOC NO.                  | NO. OF SHTS. | CAT     | CRITICAL FOR MFG?  | REQD.FOR CUSTOMER SUBMISSION? | Plan date of submission | Count of DUE as on Dt. | STATUS          | Rev-0                     |    |         |
|       |                        |                              | NO.          | (A / I) | (Y/N)              | (Y/N)                         | dd-mmm-yyyy             |                        | " /PV/PB /PC/AA | SD                        | AD | APP.CAT |
|       |                        | " " - Not yet Due.           |              |         |                    |                               |                         |                        |                 |                           |    |         |
|       |                        | OD-Overdue                   |              |         |                    |                               | TOTAL "OD"              |                        | 0               |                           |    |         |
|       |                        | " " - Not yet Due.           |              |         |                    |                               |                         |                        |                 |                           |    |         |

|                             |                |                               |                            |                             |                                       |                      |                               |                          |                |
|-----------------------------|----------------|-------------------------------|----------------------------|-----------------------------|---------------------------------------|----------------------|-------------------------------|--------------------------|----------------|
| Vendor documentation status |                |                               |                            |                             |                                       |                      |                               |                          |                |
| Total No of Docs            | Due as on Date | Submitted by vendor as on Dt. | Approved by BHEL as on Dt. | Commented by BHEL as on Dt. | Pending with BHEL/CUSTOMER as on date | %age of Dos Approved | %age of critical Dos Approved | Is Mfg. Clearance given? | Status/Remarks |
| (Nos)                       | (Nos)          | (Nos)                         | (Nos)                      | (Nos)                       | (Nos)                                 | % age                | % age                         | (Y/N)./(If Y) put Dt.    |                |
| 0                           | 0              | 0                             | 0                          | 0                           | 0                                     | #DIV/0!              | 0.00%                         | Y                        |                |

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-10        |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                                                |                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <p style="text-align: center;"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1 style="margin: 0;">Annexure-10</h1> <h2 style="margin: 0;">Deviation Format</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

**ANNEXURE-10: DEVIATION FORMAT**

| Sl. No. | Section / Part/Subsection | Page No. | Clause No. | Bid Specification Requirement | Bidder's Deviation |
|---------|---------------------------|----------|------------|-------------------------------|--------------------|
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |
|         |                           |          |            |                               |                    |

**Notes:**

1. Bidder to furnish duly filled format along with SEAL & SIGN along with their offer.
2. All the pre-bid queries (if any) shall be raised before submission of the offer as per pre-bid query format (Annexure- 11).
3. Deviations, which are impractical, and the same were raised during pre-bid stage as per pre-bid query format (Annexure- 12), but still purchaser's reply/clarifications could not be met shall only be raised in this format.
4. If there are no deviations, bidders shall indicate as "No deviation" and submit the same along with their offer.



5. Deviations indicated elsewhere in bidders offer except raised through this format shall not be considered and reviewed during technical evaluation of their offer.

SIGNATURE : \_\_\_\_\_  
NAME : \_\_\_\_\_  
DESIGNATION : \_\_\_\_\_  
COMPANY : \_\_\_\_\_  
DATE : \_\_\_\_\_

COMPANY SEAL

|                       |                                                                                   |                                                                                                                                              |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| ESP-001-<br>2A Rev.00 |  | <b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>PROJECT ENGINEERING &amp; SYSTEMS DIVISION</b><br><b>RAMACHANDRAPURAM: HYDERABAD - 502 032</b> | Std. / Doc. Number |    |
|                       |                                                                                   |                                                                                                                                              | Annexure-11        |    |
|                       |                                                                                   |                                                                                                                                              | Rev. No.           | 00 |

|                                                                                                                                                                                                                                                                                |                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <p style="text-align: center;"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p>The information on this document is the property of <b>BHARAT HEAVY ELECTRICALS LIMITED</b>,<br/>It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> | <h1 style="margin: 0;">Annexure-11</h1> <h2 style="margin: 0;">Prebid Clarification Format</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|

| Revisions:                   | Prepared by : | Checked by : | Approved by :        | Date :   |
|------------------------------|---------------|--------------|----------------------|----------|
| Refer to record of revisions | RATISH KUMAR  | GIRISH PALO  | SURYA SATYA NAGESH M | 10.03.20 |

### ANNEXURE-11: PRE-BID QUERIES FORMAT

| Sl. No. | Section / Part/Subsection | Page No. | Clause No. | Bid Specification | Bidder's Query | Purchaser's Reply |
|---------|---------------------------|----------|------------|-------------------|----------------|-------------------|
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |
|         |                           |          |            |                   |                |                   |

**Note:** During Preparation of Pre-Bid Queries, Complete Tender Specification (along with all Annexures) shall also be referred.