

|                       |                                                                                   |                                                                                                                         |                    |    |
|-----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------|----|
| 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>PY51484</b>     |    |
|                       |                                                                                   |                                                                                                                         | Rev. No.           | 00 |
|                       |                                                                                   |                                                                                                                         | Sheet 1 of 23      |    |

**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

### FOAM PUMP WITH DRIVES

|                   |                                                                       |
|-------------------|-----------------------------------------------------------------------|
| <b>PROJECT</b>    | <b>1X660 MW PANKI THERMAL POWER STATION,<br/>PANKI, UTTAR PRADESH</b> |
| <b>CUSTOMER</b>   | <b>UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM<br/>LIMITED</b>           |
| <b>CONSULTANT</b> | <b>M/s DEVELOPMENT CONSULTANTS PVT. LTD.<br/>M/s NTPC</b>             |

| <b>Revisions:</b><br>Refer to record of<br>revisions | <b>Prepared by :</b>                                                                               | <b>Checked by :</b>                                                                                       | <b>Approved by :</b>                                                                                         | <b>Date :</b> |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------|
|                                                      | <br>RAJEEV JAIN | <br>GIRISH PRASAD PALO | <br>SURYA SATYA NAGESH M | 16.05.2020    |



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

Std. / Doc. Number

**PY51484**

Rev. No. 00

Sheet 2 of 23

## 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    | Equipment qualification criteria (EQC)     |
| 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                              |



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 3 of 23

**LIST OF ENCLOSURES**

|  |                                                                                                                                                                                                                                                                                           |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Annexure 1 - P&ID for Pump & Drive assembly, Layout , Exhaust Piping layout                                                                                                                                                                                                               |
|  | Annexure 2 - Foam Pump-Motor-Engine datasheet                                                                                                                                                                                                                                             |
|  | Annexure 3 - Foam Pump assembly Price bid Format                                                                                                                                                                                                                                          |
|  | Annexure 4 - Foam Pump assembly Checklist                                                                                                                                                                                                                                                 |
|  | Annexure 5- Customer/Consultant specification<br>Annexure 5- A: Technical Specification Motors<br>Annexure 5- B: General Fire Specification<br>Annexure 5- C: C&I Specification, I/O List<br>Annexure 5- D: Packing and Forwarding specification<br>Annexure 5- E: Painting specification |
|  | Annexure 6 - <del>Foam Pump assembly Experience Record Proforma</del> (Void)                                                                                                                                                                                                              |
|  | Annexure 7 - Foam Pump assembly QAP Guide Line & Formats                                                                                                                                                                                                                                  |
|  | Annexure 8- Sub-vendor List                                                                                                                                                                                                                                                               |
|  | Annexure 9 - Foam Pump assembly Master DOC List Format                                                                                                                                                                                                                                    |
|  | Annexure 10- Deviation Format                                                                                                                                                                                                                                                             |
|  | Annexure 11- Pre-bid clarification format                                                                                                                                                                                                                                                 |



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 4 of 23

**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-2**)
- 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-3**) indicating quoted/ not quoted against each row & column.
- vi. Checklist as per (**Annexure-4**)
- vii. Equipment qualification criteria / PTR / Reference Lists as per (**Annexure-6**)
- 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.**



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

## 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 **Foam Pumps** 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 In case 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

**PY51484**

Rev. No. 00

Sheet 6 of 23

### 3. PROJECT INFORMATION

|                           |                                                           |                                                                     |                |                                                                                          |         |
|---------------------------|-----------------------------------------------------------|---------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------|---------|
| Sl.No.                    | Owner                                                     | UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED                    |                |                                                                                          |         |
| 1.                        | Project                                                   | 1X660 MW PANKI THERMAL POWER STATION, PANKI, UTTAR PRADESH          |                |                                                                                          |         |
| 2.                        | Owner’s consultant                                        | DEVELOPMENT CONSULTANTS PVT. LTD                                    |                |                                                                                          |         |
| 3.                        | Location                                                  | Panki, Kanpur, Uttar Pradesh.                                       |                |                                                                                          |         |
| 4.                        | Nearest Airport                                           | Kanpur                                                              |                |                                                                                          |         |
| 5.                        | Nearest Railway Station                                   | Panki                                                               |                |                                                                                          |         |
| 6.                        | Access to site                                            | As per geographical location                                        |                |                                                                                          |         |
| 7.                        | Co-ordinates                                              | North: N 26 <sup>0</sup> 28’20’’<br>East: E 80 <sup>0</sup> 14’32’’ |                |                                                                                          |         |
| 8.                        | Site Ambient Condition                                    |                                                                     |                |                                                                                          |         |
|                           | Monthly mean (DBT)                                        |                                                                     | :              | Maximum                                                                                  | 44.4 °C |
|                           |                                                           |                                                                     | :              | Minimum                                                                                  | 3.8 °C  |
|                           | Extreme Recorded (DBT)                                    |                                                                     | :              | Maximum                                                                                  | 47.3 °C |
|                           |                                                           |                                                                     |                | Minimum                                                                                  | -0.9 °C |
|                           | Monthly mean (WBT)                                        |                                                                     | :              | Maximum                                                                                  | 27.3 °C |
|                           |                                                           |                                                                     |                | Minimum                                                                                  | 9.2 °C  |
|                           | Relative Humidity                                         |                                                                     | :              | Maximum                                                                                  | 84 %    |
|                           |                                                           |                                                                     | Minimum        | 28 %                                                                                     |         |
| Average relative humidity |                                                           |                                                                     | Annual Average | 65 %                                                                                     |         |
| Rainfall                  |                                                           | :                                                                   | Annual average | 832.6 mm                                                                                 |         |
| 9.                        | Design Ambient Temperature (deg.C)                        | 50                                                                  |                |                                                                                          |         |
| 10.                       | Design Ambient for Electrical equipment / system (deg. C) | 50                                                                  |                |                                                                                          |         |
| 11.                       | Elevation                                                 | Station Graded Level<br>Elevation from Mean sea level (MSL)         | :              | Plant FGL → RL(+) 126.0M → El(-) 0.500M<br><br>Plant FFL → RL(+) 126.5M → El(+/-) 0.000M |         |
| 12.                       | Seismic coefficient                                       | Seismic zone III as per IS 1893 Latest                              |                |                                                                                          |         |

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

### 4. APPLICATION OF SYSTEM

1 No. of Electric motor driven and 1 No of Diesel Engine driven Foam Pump (Gear Pump) [Total : 2 Nos.] is envisaged for supplying foam to foam system from the foam storage tank.



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 7 of 23

## 5. DESIGN PARAMETERS/TECHNICAL DETAILS/REQUIREMENTS

### 5.1. Design Parameters and Technical Details/Requirements of Foam Pump

| Sl. No. | Description                                  | Foam Pump                                                                                                                                                                              |
|---------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Number of Pumps & Drive                      | <b>2 Nos.</b><br><b>[1 No. Motor Driven + 1 No. Diesel Engine Driven]</b>                                                                                                              |
| 2       | Drive(Pump Supplier Scope)                   | 1 No. Motor + 1 No. Diesel Engine<br><b>All Drives shall be supplied with Controller as per NFPA 20/NFPA 70.</b>                                                                       |
| 3       | Application                                  | To transfer Foam in Fire fighting System                                                                                                                                               |
| 4       | Pump Type                                    | Gear Pump                                                                                                                                                                              |
| 5       | Pump Standard                                | <b>As Per NFPA-20</b><br><b>[The Foam pump shall be listed for Intended application as per Cl. No. 8.1.2 of NFPA-20].</b>                                                              |
| 6       | Motor Standard                               | <b>NEMA MG 1, IEC 60034-1 &amp; NFPA.</b><br><b>Motor need to be specifically listed for Fire Services.</b>                                                                            |
| 7       | Drive Controller for Motor and Diesel Engine | <b>As per NFPA-70 &amp; NFPA-20</b>                                                                                                                                                    |
| 8       | Diesel Engine Standard                       | As per NFPA 20. The Engine shall be specifically Listed for fire services.                                                                                                             |
| 9       | Design Pump Capacity                         | 6 m <sup>3</sup> /hr                                                                                                                                                                   |
| 10      | Discharge Pressure                           | 11.5 Kg/cm <sup>2</sup> (g)                                                                                                                                                            |
| 11      | Fluid Handled/Viscosity/ Temperature etc.    | Foam Type :3% Aqueous Film Forming Foam Concentrate<br><br>Appearance: Amber Color Liquid<br><br>Ph: 6.5 to 8.5<br><br>Specific Gravity: 1 to 1.05<br><br>Viscosity : Less than 10 CST |



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

|    |                                                             |                                                                                                         |
|----|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
|    |                                                             | Spreading Co-efficient: More than 3<br>Sludge Contents (% V/V) : Less than 0.1%<br>Pour Point : (-)5 °C |
| 12 | Available Pressure at Center line of Suction nozzle of Pump | 1.0 Kg/cm <sup>2</sup> (a)                                                                              |
| 13 | NPSHA at pump suction flange                                | 10.0 mtrs.                                                                                              |
| 14 | Margin between NPSHA & NPSHR                                | Sufficient for trouble free operation of pump.                                                          |
| 15 | Power Supply to Motor Controller                            | 3 phase, 415V, (+/- 10%), 50Hz (+/- 5%), SFU Feeder                                                     |
| 16 | Material of construction for Pump                           | As per NFPA-20                                                                                          |
| 17 | Area classification                                         | Safe Area                                                                                               |

## 6. SCOPE OF SUPPLY

Scope of supply shall be as per as per follows:

Please refer to the enclosed P&ID for Foam Pumps (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 [Annexure- 1 to 11].

### Quantity of Pump & Drive Assembly

2 Nos. of Foam Pumps [1 No Motor Driven +1 No Engine Driven].

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

#### 6.1. Pump

Gear Pump complete with all accessories as per specification.

***Gear pumps shall be as per NFPA-20. Scope of supply shall be as per NFPA-20 standard, Annexure-1 & subsequent clause of this specification. Pump shall be equipped with integral Relief valve as per NFPA-20.***

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

##### 6.2.1. Motor



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 9 of 23

**Voltage levels for Motors:**

Motor for Pump: 415 V

**Electric motors designed as per NEMA MG 1, IEC 60034-1 & NFPA.****The Motor shall be specifically listed for fire services.**

The manufacturer shall specify which standard is referred, and certify that the motor used is in compliance with said standard, providing any supporting documentation requested by FM Approvals / UL listed to verify compliance.

**6.2.2. Diesel Engine**

The Diesel Engines shall be NFPA-20. The scope of supply shall be as per NFPA-20 Standard, Annexure-1 & subsequent clause of this specification.

**6.2.3. Controller for Motor and Diesel Engine:****Controller for Motor:**

Dedicated Controller for Motor inline with requirements mentioned in NFPA-20/NFPA-70 and three phase NEMA Design "B" motors/ equivalent shall be considered by Bidder in their scope of Supply. The scope of supply shall be as mentioned in NFPA-20 standard.

**Controller for Diesel Engine:**

Dedicated Controller for Engine inline with requirements mentioned in NFPA-20 shall be considered by Bidder in their scope of Supply. The scope of supply shall be as mentioned in NFPA-20 standard.

Controllers for diesel engine driven pumps are used with FM /UL approved diesel engine drivers as per FM Approvals (standard Class 1333) / UL standard.

**All cabling [control/signal/power] from Controller to Motor, Controller to Engine-Battery-Battery charger etc. shall be in bidder scope of supply. Bidder to furnish cable BOQ & electrical loads.**

**Notes:**

1. All wiring on the engine, including starting circuitry, shall be sized on a continuous-duty basis. Battery cables shall be sized in accordance with the engine manufacturer's recommendations considering the cable length required for the specific battery location.
2. The controller for the motor shall be DOL type.

**Software:**

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



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet **10** of **23**

### 6.2.3.1. Terminal point for power supply

BHEL shall provide 1 no of feeder [415 V, (+/-) 10%, 3 phase, 50 Hz] for each Controller for Motor driven Foam Pump. Further distribution shall be in bidder scope of supply. Required cable glands, lugs shall be in bidder scope of supply

BHEL shall provide 1 no of feeder [240 V, (+/-) 10%, 3 phase 50 Hz] for each Controller for Engine driven Foam Pump. Further distribution shall be in bidder scope of supply.

### 6.2.3.2. Diesel Engine Fuel Tank

Fuel supply tank shall have a capacity at least equal to 1 gal per hp (5.07 L per kW), plus 5 percent volume for expansion and 5 percent volume for sump.

An overfill protection for the tank shall be provided. Level indicator and Level Transmitter, required piping [5 m length minimum], valves [from tank to engine and engine to tank] etc 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. Fuel piping shall be as per NFPA. Please refer Annexure 1 for layout of various equipment's of Pump skid.

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. .

For details [such as pipe size, fill-drain-vent connections etc.] pl refer Annexure-1 & NFPA.

### 6.2.3.3. Diesel Engine Exhaust System

The exhaust system shall be gas tight throughout the operating range of exhaust temperatures and pressures. It shall be designed with an outlet connection to readily duct exhaust gases outside the engine room and away from air-intake systems. The system shall be sized in accordance with the manufacturer's recommendations, and arranged to preclude the entry of water into the pump room. The exhaust manifold and turbocharger housing (when provided by the drive manufacturer) shall be suitably guarded, insulated, or cooled to prevent fire hazards and injury to operators. Each diesel engine foam pump driver in a multiple engine room shall have an independent exhaust system.

Bidder to consider suitable length of exhaust piping with silencer, SS metal expansion below & insulation with required number of bends as per NFPA-20. However, As a minimum 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.



#### 6.2.3.4. Starting & Charging System

Starting & charging system shall be as per NFPA-20 Standard.

##### Starting system:

- i. Two (2) sets (1 working & 1 standby, 100% capacity) of 24 or 12 Volt (as applicable) Automotive type battery with charger for each diesel engine driven foam pumps shall be provided. Batteries shall be sized considering the maximum parasitic loads allowed by NFPA20 for the engine, controller, and other skid equipments.
- ii. Each engine shall be provided with 2 Nos. of Lead-acid plante battery units as per IS. Battery shall be sized as per NFPA-20 Standard.
- iii. The starting system shall be compatible with NFPA-20 listed controllers.
- iv. 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.

##### Charging system:

All starting systems shall be rechargeable by both engine-driven and auxiliary devices. The systems shall be arranged so that a NFPA-20 listed controller maintains fully charged starting energy reservoirs by means of the auxiliary recharging device.

Controllers shall provide alternate starts on alternate batteries, so a design using battery starting shall include all necessary contactors and wiring. Alternatively, the monitoring system shall note the level of charge on both batteries, and select the battery with the highest level of charge remaining. Accordingly, each diesel engine shall be provided with two (2) battery charger units. 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.

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

Coupling between pump and drive shall be as per NFPA-20 Standard.

#### 6.4. Mechanical Seal

Sealing arrangement shall be as per NFPA-20 Standard.

#### 6.5. Baseplate

The baseplate with fixing bolts shall be suitably designed to support the pump and driver without excessive vibration or visible distortion at all variations of load.



### 6.6. Interconnecting Piping & Instrumentation

Interconnecting piping and instrumentation as per P&ID [Annexure-1] & relevant standards as mentioned in this specification.

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:** Stainless steel to ASTM A-312, TP-304, Sch.- 40s.

**Flanges:** Plate fabricated to ASTM A-240, TP-304

**Fittings:** SS forged to ASTM-A-182, F-304 for sizes 15NB to 40NB and S.S. seamless to ASTM-A- 403, WP-304, Schedule-40 for sizes 50NB & above.

**Gasket:** CAF as per IS:2712, Gr.W3.

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. First Fill of Lubricant & Consumables

Excluded from bidder scope of supply. However, bidder to furnish detailed requirement of first fill of lubricants and consumables.

### 6.9. Complete Unit Test:

#### 1) Motor driven Foam Pump:

Pump shall be tested with Job motor, Job coupling, and Job base plate etc.

#### 2) Engine driven Foam Pump:

Pump shall be tested with 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.

### 6.10. All other items necessary for safe and smooth running of Pump & accessories required to make the supplied equipment complete in all respect.

### 6.11. Commissioning Spares

- i. One set of commissioning spares for Pump with drive motor shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain minimum 1 Set of



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 13 of 23

O rings & gaskets for each Pump & 1 Set of Commissioning Spares for Motor, Controller etc as per Manufacturer recommendation.

- ii. One set of commissioning spares for Pump with Diesel Engine 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 Engine, Controller, Battery etc as per Manufacturer recommendation.

1 set stands for requirement for one no. of skid. Bidder to furnish the list along with the offer. Bidder shall include all the required commissioning spares in their scope of supply and ensure that the erection and commissioning of the plant is not delayed for want of Commissioning spares.

Prices for the commissioning spares shall be part of main scope of supply. No separate price shall be offered for the same.

Any leftover (unused) spares after commissioning, out of those included by vendor, shall be handed over to the owner.

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

#### **6.12. Mandatory Spares:**

##### **6.12.1. For Foam Pump with drive assembly**

##### **For Foam Pump - Motor:**

| Sl. No. | Description | Quantity | Unit |
|---------|-------------|----------|------|
| i)      | Bearings    | 2        | Sets |

##### **For Field Devices**

| Sl. No. | Description        | Quantity of Each Variety |
|---------|--------------------|--------------------------|
| i)      | Pressure gauges    | Five (5)                 |
| ii)     | Temperature gauges | Two (2)                  |
| iii)    | Level Indicator    | Two (2)                  |
| iv)     | Pressure switches  | Five (5)                 |



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

**Special notes for Mandatory spares:**

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

**6.13. Auxiliaries Equipment's/Spares**

Bidder to include all auxiliary equipment, if applicable, shall be considered by bidder in their scope as per NFPA-20 in addition to above mandatory spares.

**6.14. Special Tools And Tackles**

2 Sets of Special tools and tackles for Pump & Drive assembly. [1 set each for Pumps with Motor assembly & Pumps with Diesel Engine assembly]

One set (1 Set) of Special tools and tackles comprises of special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance (disassemble, assemble, or maintaining the unit) of the Pump and Drive [Motor/Engine] assembly shall be quoted as per manufacturer's recommendation.

1 set stands for requirement for one no. of skid. Bidder to furnish the list along with the offer.

Prices for Special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.

**6.15. 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:



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet **15** of **23**

- 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 Please price bid format]

**Foam Pump (Gear Pump) with Drives:**

Two Man-days for Pump/Motor & Controller/Diesel Engine & Controller  
 One Visit

**Notes:**

1. 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.
2. All payments towards supervision of E&C shall be made only after BHEL-site certification.
3. 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.
4. Bidder to quote supervision of erection and commissioning activities strictly as per BHEL's price format

**6.16. Conflicts in Specification Requirement:**

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

**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.

**Engine Revalidation spares:**

Revalidation spares are those spares, which are required at the time of commissioning of Engine, in case the scheduled commissioning of engine is delayed beyond the permissible duration as recommended OEM.



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

Bidder to quote revalidation spares required for Engine as per OEM practice under optional prices as indicated in price bid format, sl no II-A.

Bidder shall furnish list of revalidation spares along with their offer.

## **8. EQUIPMENT QUALIFICATION CRITERIA (EQC) : 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**, ITPs for Pump, Motor, Engine, Controller etc. In addition, Annexure-7 & enclosed datasheets, specifications and applicable NFPA Standard shall be referred.

### **9.2. Inspection Agency**

BHEL/ Customer/Consultant/Third Party appointed by BHEL. Bidder to appoint TPI agency from the following on behalf of BHEL for inspection of items sourced from outside India:

i. Lloyds Register of Industrial Services (LRIS), ii. Bureau Veritas (BV), iii. Det Norske Veritas (DNV), iv. Certification Engineers International Ltd. (CEIL), v. TUV

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

Pl refer Annexure: 7, ITPs for Pump, Motor, Engine etc. In addition, annexure-7 & enclosed datasheets, specifications and applicable FM/UL standards shall be referred.

### **9.3. Testing**

The design and Testing Standards, Performance tolerances of the Pumps, Motor, Diesel Engines shall be as per NFPA-20 standard.

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.



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

## 10. PAINTING

Painting for Pump, Motor, Engine and all other accessories shall be as per annexure -5.

**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 suitable for as per manufacturing standard meeting the requirement (Sea Worthy Packing) is acceptable. Packing shall be suitable for outdoor storage: More than 12 months. For details Pl. refer Annexure -4.

## 12. SUB VENDORS

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.

## 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**



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 18 of 23

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**

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



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet 19 of 23

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                                                                                                               |
| 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                                                                                             |



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet **20** of **23**

|    |                                                                                  |    |                                                                                   |
|----|----------------------------------------------------------------------------------|----|-----------------------------------------------------------------------------------|
| 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.
- Operation, Instruction & maintenance manuals of all equipments / items for the complete package
- System unloading, storage erection, start up, commissioning, shut down requirements.
- Operational & environmental safety instructions.
- Test reports and certificates.
- 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.



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

Std. / Doc. Number

**PY51484**

Rev. No.

00

Sheet **21** of **23**

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.

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.



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

Std. / Doc. Number

**PY51484**

Rev. No. 00

Sheet 22 of 23

**16. VARIANT TABLE:**

| Variant | Item                                      | Material Code |
|---------|-------------------------------------------|---------------|
| 01      | Foam Pump Motor Driven with CS and ST     | PY9751484014  |
| 02      | Foam Pump engine driven with CM and ST    | PY9751484022  |
| 03      | Supervision of E& C of Foam Pump assembly | PY9851484032  |
| 05      | Foam Pump mandatory spare                 | PY9751484057  |



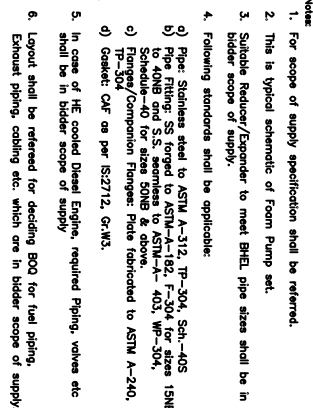
|                        |                                                                                                                                                                     |                                                                                                            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

|                                                                                                                                                                                                                                                    |                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <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> | <div>Annexure-1</div> <div>(P&amp;ID FOR FOAM SYSTEM,LAYOUT FOR FOAM SYSTEM)</div> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|

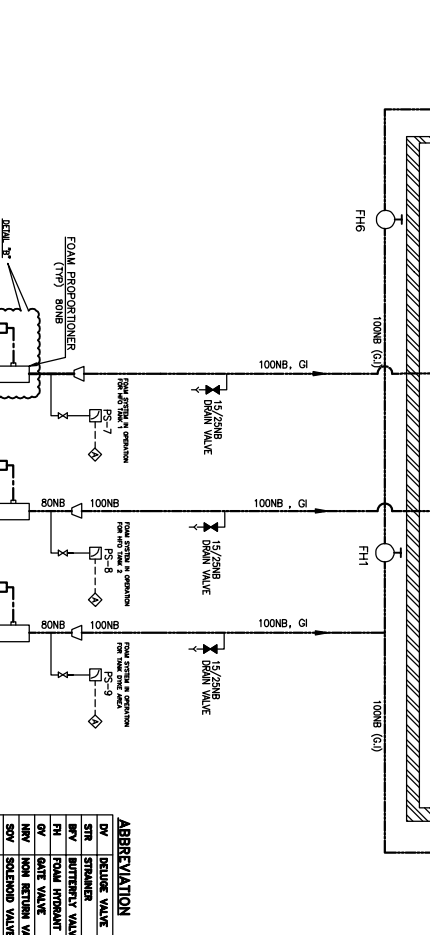
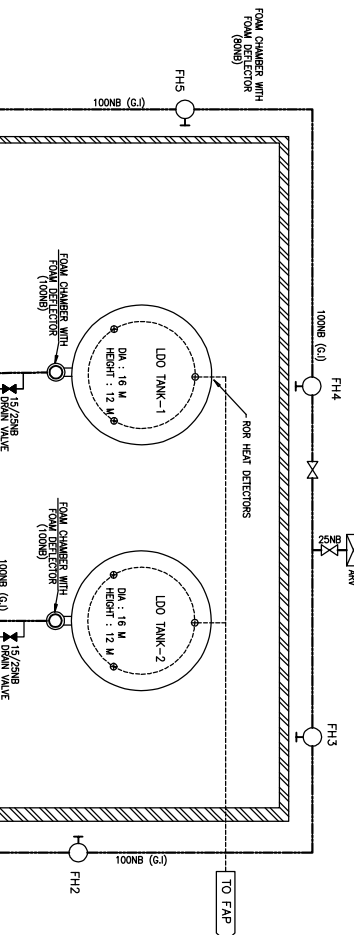
|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

SUCTION LINE SIZE 50 NB (SS)

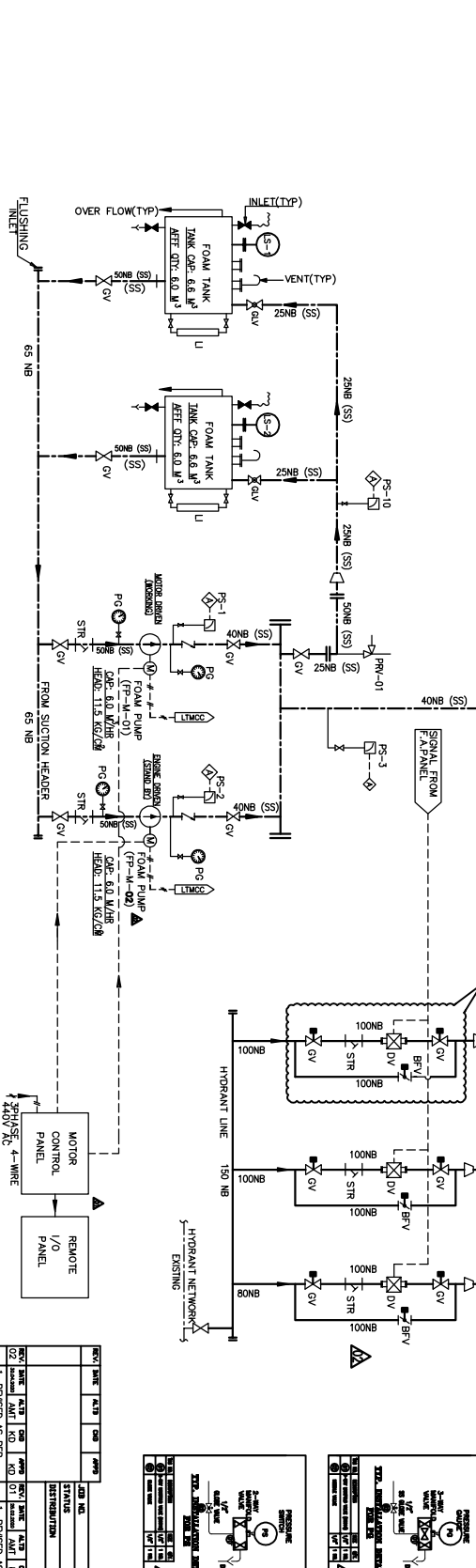
DISCHARGE LINE SIZE 40 NB (SS)



|      |                |    |
|------|----------------|----|
| CODE | CUST. DRG. NO. | 00 |
| NA   |                |    |



|    |                 |
|----|-----------------|
| DC | DIESEL ENGINE   |
| MS | MILD STEEL      |
| SS | STAINLESS STEEL |
| GA | GALVANIZED IRON |

[illegible][illegible][illegible]

**▲ REF. DRAWINGS/DOCUMENTS**

1. P-104-1101-8666-01 : DESIGN PATENTGRAPH OF FOAM BASED FIRE PROTECTION SYSTEM
2. F-102-426-1101-4001 : TEST PLAN
3. 9892-001-FE-153-PHM-F-001: PPHG LAYOUT IN FIELD FROM PHM-A24
4. 9892-001-FE-153-PHM-L-001 : PHG FOR FIELD USE SYSTEM.

|                                                                                                                                                                                                                                                                                          |                                                                                                                                      |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------|------------|------|------|---|------------|----|------------|---|------------|----|------------|---|------------|----|------------|
| PROJECT                                                                                                                                                                                                                                                                                  | 1 X 660MW PAND THERMAL POWER EXTENSION PROJECT.                                                                                      |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| OWNER                                                                                                                                                                                                                                                                                    | <br>UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD. |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| CLIENTS                                                                                                                                                                                                                                                                                  | NTPC LTD.<br>(A GOVERNMENT OF INDIA ENTERPRISE)                                                                                      |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| CONSULTANTS                                                                                                                                                                                                                                                                              | <br>DEVELOPMENT CONSULTANTS PVT. LTD.<br>KOLKATA  |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| DESIGNER                                                                                                                                                                                                                                                                                 | BHARAT HEAVY ELECTRICALS LTD.                                                                                                        |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| MANUFACTURER                                                                                                                                                                                                                                                                             | <br>BHARAT HEAVY ELECTRICALS LTD.                 |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| BHARAT HEAVY ELECTRICALS LTD.<br>PROJECT ENGINEERING & STUDIES DIVISION<br>HOWRAH                                                                                                                                                                                                        |                                                                                                                                      |      |            |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| <table><tr><td>ITEM</td><td>DATE</td><td>ISSN</td><td>DATE</td></tr><tr><td>1</td><td>10/01/2011</td><td>20</td><td>20.01.2011</td></tr><tr><td>2</td><td>10/01/2011</td><td>20</td><td>20.01.2011</td></tr><tr><td>3</td><td>10/01/2011</td><td>20</td><td>20.01.2011</td></tr></table> |                                                                                                                                      | ITEM | DATE       | ISSN | DATE | 1 | 10/01/2011 | 20 | 20.01.2011 | 2 | 10/01/2011 | 20 | 20.01.2011 | 3 | 10/01/2011 | 20 | 20.01.2011 |
| ITEM                                                                                                                                                                                                                                                                                     | DATE                                                                                                                                 | ISSN | DATE       |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| 1                                                                                                                                                                                                                                                                                        | 10/01/2011                                                                                                                           | 20   | 20.01.2011 |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| 2                                                                                                                                                                                                                                                                                        | 10/01/2011                                                                                                                           | 20   | 20.01.2011 |      |      |   |            |    |            |   |            |    |            |   |            |    |            |
| 3                                                                                                                                                                                                                                                                                        | 10/01/2011                                                                                                                           | 20   | 20.01.2011 |      |      |   |            |    |            |   |            |    |            |   |            |    |            |

| FOR I660MW PANMI TPS             |              |      |
|----------------------------------|--------------|------|
| A. OLSEN ENGINEERING CORPORATION |              |      |
| TITLE                            | DRAWING NO.  | REV. |
| P & I DIAGRAM OF FOAM SYSTEM     | SHEET 1 OF 1 | 02   |
| PY-W-1-MIOT-8886-01              |              |      |

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

|                                                                                                                                                                                                                                                    |                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <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> | <div>Annexure-2</div> <div>(DATA SHEET FOR PUMP-MOTOR-ENGINE)</div> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

**ANNEXURE-2 : DATA SHEET FOR FOAM PUMP -MOTOR-DIESEL ENGINE**

| Sl.no.                                      | Description                                                         | BHEL Requirement                                                                                                                                                                                                                                                                 | Bidder's Details |
|---------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>GENERAL DATA</b>                         |                                                                     |                                                                                                                                                                                                                                                                                  |                  |
| 1                                           | Service                                                             | <b>Foam Pump</b> : For supplying the foam to the foam system from the foam tank                                                                                                                                                                                                  |                  |
| 2                                           | Number of Pumps                                                     | 2 Nos [1 Motor driven +1 Diesel Engine driven]                                                                                                                                                                                                                                   |                  |
| 3                                           | Location                                                            | Indoor                                                                                                                                                                                                                                                                           |                  |
| 4                                           | Duty                                                                | Motor driven - Continuous<br>Engine driven - Intermittent                                                                                                                                                                                                                        |                  |
| 5                                           | Drives                                                              | Motor & Diesel Engine                                                                                                                                                                                                                                                            |                  |
| 6                                           | Pumping fluid /Viscosity/Sp Gr                                      | Foam Type :3% Aqueous Film Forming Foam Concentrate<br>Apperance: Amber Color Liquid<br>Ph: 6.5 to 8.5<br>Specific Gravity: 1 to 1.05<br>Viscosity : Less than 10 CST<br>Spreading Co-efficient: More than 3<br>Sludge Contents (% V/V) : Less than 0.1%<br>Pour Point : (-)5 °C |                  |
| 7                                           | Fluid temp. Deg C                                                   | Ambient                                                                                                                                                                                                                                                                          |                  |
| <b>PUMP PERFORMANCE &amp; OTHER DETAILS</b> |                                                                     |                                                                                                                                                                                                                                                                                  |                  |
| 8                                           | Pump Type                                                           | Gear Pump                                                                                                                                                                                                                                                                        |                  |
| 9                                           | Design Standard of pump                                             | As Per NFPA-20.Pump Shall be Listed for intended application.                                                                                                                                                                                                                    |                  |
| 10                                          | Rated Flow (m <sup>3</sup> /hr)                                     | 6                                                                                                                                                                                                                                                                                |                  |
| 11                                          | Rated Differential Head in Kg/cm <sup>2</sup> (g)                   | 11.5                                                                                                                                                                                                                                                                             |                  |
| 12                                          | Temperature of pumping fluid                                        | Ambient                                                                                                                                                                                                                                                                          |                  |
| 13                                          | Pump Model No.                                                      | Pump model shall be interchangeable for both Motor & Engine driven pump. Bidder to indicate pump model                                                                                                                                                                           |                  |
| 14                                          | Pump end connection                                                 | Side Suction<br>Side Discharge                                                                                                                                                                                                                                                   |                  |
| 16                                          | Rated Speed of Pump (rpm)                                           | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 17                                          | Rated speed of Motor (rpm)                                          | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 18                                          | Rated speed of Engine (rpm)                                         | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 19                                          | Pump Efficiency in %                                                | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 20                                          | Available Pressure at centre line of Suction nozzle of Pump m/c     | 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)                                                   | Sufficient for trouble free operation of pump.                                                                                                                                                                                                                                   |                  |
| 26                                          | Material of Construction:                                           | As per NFPA-20                                                                                                                                                                                                                                                                   |                  |
| 27                                          | Type of main bearings for pump                                      | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 28                                          | Main bearings lubrication                                           | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 29                                          | Direction of rotation of Pump                                       | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 30                                          | Direction of rotation of Motor                                      | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 31                                          | Direction of rotation of Engine                                     | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| <b>COUPLING</b>                             |                                                                     |                                                                                                                                                                                                                                                                                  |                  |
| 32                                          | Coupling standard                                                   | As per NFPA-20                                                                                                                                                                                                                                                                   |                  |
| 33                                          | Type of coupling                                                    | As per NFPA-20                                                                                                                                                                                                                                                                   |                  |
| 34                                          | Non sparking type couplign guard                                    | Yes                                                                                                                                                                                                                                                                              |                  |
| 35                                          | Service factor for the coupling                                     | 1.5                                                                                                                                                                                                                                                                              |                  |
| <b>PERFORMANCE TEST STANDARD FOR PUMPS</b>  |                                                                     |                                                                                                                                                                                                                                                                                  |                  |
| 36                                          | Performance test standard                                           | As per NFPA-20                                                                                                                                                                                                                                                                   |                  |
| 37                                          | Maximum Allowed Working Pressure (MAWP) in Kg/cm <sup>2</sup> (g)   | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 38                                          | Hydraulic test pressure of casing Kg/cm <sup>2</sup> (g)            | Bidder To Furnish                                                                                                                                                                                                                                                                |                  |
| 39                                          | Noise level for Pump and motor assembly                             | 85 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                         |                  |
| 40                                          | Noise level for Pump and engine assembly                            | 105 DBA at 1 m distance, in any direction                                                                                                                                                                                                                                        |                  |
| 41                                          | Vibration for Pump                                                  | As ISO 10816                                                                                                                                                                                                                                                                     |                  |
| <b>PUMP TERMINAL POINT DETAILS</b>          |                                                                     |                                                                                                                                                                                                                                                                                  |                  |
| 43                                          | Pump Suction nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing | Bidder To Indicate                                                                                                                                                                                                                                                               |                  |

|                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                          |  |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 44                                                                                             | Pump Discharge nozzle<br>- Size<br>- Rating<br>- Standard<br>- Facing<br>- Location                                                                                                                                                                                                                                                                                                       | Bidder To Indicate                                                                                                                                       |  |
|                                                                                                | Expander meeting BHEL suction pipe size as per Annexure-1                                                                                                                                                                                                                                                                                                                                 | Bidder to provide                                                                                                                                        |  |
| 44                                                                                             | Expander meeting BHEL discharge pipe size as per Annexure-1                                                                                                                                                                                                                                                                                                                               | Bidder to provide                                                                                                                                        |  |
| <b>MOTOR DETAILS FOR MOTOR DRIVEN PUMPS [For More Details Please refer enclosed annexures]</b> |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                          |  |
| 45                                                                                             | Drive/Installation                                                                                                                                                                                                                                                                                                                                                                        | Motor/Horizontal                                                                                                                                         |  |
| 46                                                                                             | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                    | Bidder To Indicate                                                                                                                                       |  |
| 47                                                                                             | BKW at 110% of RV Pressure                                                                                                                                                                                                                                                                                                                                                                | Bidder To Indicate                                                                                                                                       |  |
| 48                                                                                             | Selected drive rating in kW:<br>Continuous drive motor rating (at 50 degree C ambient) shall be Drive Unit Power rating for the foam Pump shall be selected such that it is equal to higher of the following conditions and duly taking care of requirement mentioned in NFPA-20:<br>(i) 115% of the duty point power requirement.<br>(ii) Motor Input power required at 110% RV Pressure | Bidder to mention motor kW rating for the motor duly taking care of requirements.                                                                        |  |
| 49                                                                                             | Design Standard of Motor                                                                                                                                                                                                                                                                                                                                                                  | <b>NEMA MG 1, IEC 60034-1 &amp; NFPA.<br/>Motor need to be specifically listed for Fire Services.</b>                                                    |  |
| 50                                                                                             | Manufacturer                                                                                                                                                                                                                                                                                                                                                                              | As per attached subvendor list                                                                                                                           |  |
| 51                                                                                             | 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                                   |  |
| 52                                                                                             | Area classification for motor                                                                                                                                                                                                                                                                                                                                                             | Safe Area                                                                                                                                                |  |
| 53                                                                                             | Rated Voltage & Frequency                                                                                                                                                                                                                                                                                                                                                                 | 415 V & 50 Hz                                                                                                                                            |  |
| 54                                                                                             | Permissible variations in Voltage/Frequency/Combined                                                                                                                                                                                                                                                                                                                                      | Voltage: (+/-)10%<br>Frequency:(+/-)5%<br>Combined: (+/-)10% combined variation of voltage and                                                           |  |
| 55                                                                                             | No of poles / synchronous speed                                                                                                                                                                                                                                                                                                                                                           | Bidder To Furnish                                                                                                                                        |  |
| 56                                                                                             | Energy efficient class                                                                                                                                                                                                                                                                                                                                                                    | IE3                                                                                                                                                      |  |
| 57                                                                                             | Starting Current as % of FLC                                                                                                                                                                                                                                                                                                                                                              | Bidder To Furnish                                                                                                                                        |  |
| 58                                                                                             | Method of Starting                                                                                                                                                                                                                                                                                                                                                                        | AC squirrel cage industrial motors shall be fed through the Dedicated drive controller. The Input power to the controller shall be 415V, 3 phase, 50 Hz. |  |
| 59                                                                                             | Method of cooling                                                                                                                                                                                                                                                                                                                                                                         | Bidder To Furnish                                                                                                                                        |  |
| 60                                                                                             | Winding and Insulation                                                                                                                                                                                                                                                                                                                                                                    | All motors shall have class F insulation but limited to class B temperature rise                                                                         |  |
| 61                                                                                             | Temp. rise                                                                                                                                                                                                                                                                                                                                                                                | All motors shall have class F insulation but limited to class B temperature rise                                                                         |  |
| 62                                                                                             | Degree of protection/Canopy Required                                                                                                                                                                                                                                                                                                                                                      | IP 55/Yes                                                                                                                                                |  |
| 63                                                                                             | TB Short time-Current & Short time-Time                                                                                                                                                                                                                                                                                                                                                   | 50 kA , 1 Sec                                                                                                                                            |  |
| 64                                                                                             | Cable, Cable glands & Lugs                                                                                                                                                                                                                                                                                                                                                                | Suitable double compression Nickel plated brass cable glands and Tinned copper lugs to be provided by the                                                |  |
| 65                                                                                             | No. of Starts                                                                                                                                                                                                                                                                                                                                                                             | Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.   |  |
| 66                                                                                             | Bearing RTDs, Winding RTDs & TGs                                                                                                                                                                                                                                                                                                                                                          | Not Applicable                                                                                                                                           |  |
| 67                                                                                             | Noise                                                                                                                                                                                                                                                                                                                                                                                     | 85 DBA at 1 m distance from motor body, in any direction                                                                                                 |  |
| 68                                                                                             | Vibration                                                                                                                                                                                                                                                                                                                                                                                 | As per IS 4729                                                                                                                                           |  |
| <b>DIESEL ENGINE DETAILS FOR ENGINE DRIVEN PUMPS</b>                                           |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                          |  |
| 69                                                                                             | Drive                                                                                                                                                                                                                                                                                                                                                                                     | Diesel Engine                                                                                                                                            |  |
| 70                                                                                             | Type                                                                                                                                                                                                                                                                                                                                                                                      | Bidder to Furnish                                                                                                                                        |  |
| 71                                                                                             | Location                                                                                                                                                                                                                                                                                                                                                                                  | Indoor                                                                                                                                                   |  |
| 72                                                                                             | BKW at the rated point                                                                                                                                                                                                                                                                                                                                                                    | Bidder To Indicate                                                                                                                                       |  |
| 73                                                                                             | BKW at 110% of RV Pressure                                                                                                                                                                                                                                                                                                                                                                | Bidder To Indicate                                                                                                                                       |  |

|                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                       |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--|
| 74                                                                                                                                                                                                                                                                | <p>Selected drive rating shall be as follows:</p> <p>The horsepower capability of the engine shall have a 4-hour minimum horsepower rating not less than 10 percent greater than the listed horsepower on the engine nameplate.</p> <p>A deduction of 3 percent from engine horsepower rating at standard SAE conditions shall be made for diesel engines for each 1000 ft (300 m) of altitude above 300 ft (91 m).</p> <p>A deduction of 1 percent from engine horsepower rating as corrected to standard SAE conditions shall be made for diesel engines for every 10°F (5.6°C) above 77°F (25°C) ambient temperature.</p> <p>As Per NFPA Horsepower rating adjustments for installation conditions are made for increased elevation and increased operating temperature in accordance with NFPA 20, Sections 11.2.2.4 and 11.2.2.5, plus Graphs A11.2.2.4 and A11.2.2.5</p> | Bidder to mention engine HP rating for the motor duly taking care of the requirements.                                                |  |
| 75                                                                                                                                                                                                                                                                | Drive Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | As per NFPA 20. The Engine shall be specifically Listed for fire services.                                                            |  |
| 76                                                                                                                                                                                                                                                                | Name of Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Bidder to furnish.                                                                                                                    |  |
| 77                                                                                                                                                                                                                                                                | Model No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Bidder to furnish.                                                                                                                    |  |
| 78                                                                                                                                                                                                                                                                | Duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Intermittent.<br>However, same shall be capable of operating continuously on full load at the site elevation for a period of 1 hours. |  |
| 79                                                                                                                                                                                                                                                                | Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bidder to Furnish                                                                                                                     |  |
| 80                                                                                                                                                                                                                                                                | Type of cooling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bidder to Furnish                                                                                                                     |  |
| 81                                                                                                                                                                                                                                                                | Noise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 105 DBA at 1 m distance, in any direction                                                                                             |  |
| 82                                                                                                                                                                                                                                                                | Vibration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | As per IS standard                                                                                                                    |  |
| <p><b>Note: Individual datasheets for Pump, Motor &amp; Diesel shall be furnished during detailed engg stage. It is mandatory for the equipment supplier to furnish in format [to be submitted during detailed engg stage] in case of placement of order.</b></p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                       |  |

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

|                                                                                                                                                                                                                                                                                |                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| <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-3</h1> <h2>(PRICE BID FORMAT)</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

| Annexure-3A                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------|------------------------------------------|--------------|---------|
|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <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 FOAM PUMP(GEAR PUMP) WITH DRIVES ( MOTOR &amp; DIESEL ENGINE)</b><br><b>PROJECT: 1X660 MW PANKI THERMAL POWER STATION, PANKI, UTTAR PRADESH</b><br><b>CUSTOMER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED</b><br><b>CONSULTANT : M/s DEVELOPMENT CONSULTANTS PVT. LTD. AND M/s NTPC</b> |      |                                      |                                          |              |         |
| 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>                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| <b>I MAIN OFFER</b>                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| <b>A MATERIAL SUPPLY: FOAM PUMP WITH MOTOR [Material code:PY9751484014]</b>                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| A.1                                                                                                                                                                                                                                                                                                                     | Foam Pump with Drive Motor, Controller along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                                                                | 1                                                                                                                                                                                                                                                                                                                        | Sets | 37.88                                |                                          |              |         |
| <b>B MATERIAL SUPPLY: FOAM PUMP WITH ENGINE [Material code:PY9751483026]</b>                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| B.1                                                                                                                                                                                                                                                                                                                     | Foam Pump with Diesel engine, Controller, Fuel tank, Battery, Charger etc along with all accessories including commissioning spares, special tools & tackles as per specification.                                                                                                                                                                                                                                                                                                                                             | 1                                                                                                                                                                                                                                                                                                                        | Sets | 59.2                                 |                                          |              |         |
| <b>C MATERIAL SUPPLY: Mandatory spares [Material code: PY9751484057] Refer Note-14</b>                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| C.1                                                                                                                                                                                                                                                                                                                     | <b>Motor-Mandatory spares for Motor of Pump</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| i)                                                                                                                                                                                                                                                                                                                      | Bearings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                                                                                                                                                                                                                                        | Sets | 1.46                                 |                                          |              |         |
| <b>C.2 Instrumentation -Mandatory spares</b>                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| j)                                                                                                                                                                                                                                                                                                                      | Pressure gauges(of Each Variety, Range etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 5                                                                                                                                                                                                                                                                                                                        | Nos  |                                      |                                          |              |         |
| ii)                                                                                                                                                                                                                                                                                                                     | Temperature gauges(of Each Variety, Range etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2                                                                                                                                                                                                                                                                                                                        | Nos  |                                      |                                          |              |         |
| iii)                                                                                                                                                                                                                                                                                                                    | Level Indicator(of Each Variety, Range etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2                                                                                                                                                                                                                                                                                                                        | Nos  |                                      |                                          |              |         |
| iv)                                                                                                                                                                                                                                                                                                                     | Pressure switches(of Each Variety, Range etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 5                                                                                                                                                                                                                                                                                                                        | Nos  |                                      |                                          |              |         |
| <b>D Supervision charges for erection &amp; commissioning at site [Material code:PY9851484032]</b>                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
|                                                                                                                                                                                                                                                                                                                         | Supervision charges for erection & commissioning shall include the following:<br>1. Per diem charge of for supervision of erection & commissioning of <b>Pump/Motor &amp; Controller/Diesel Engine &amp; Controller etc.</b><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.<br>[Refer Note 11] | 2 Day and 1 Visit                                                                                                                                                                                                                                                                                                        |      | 1.46                                 |                                          |              |         |
| <b>Grand total price for sl no A, B, C and D (Inclusive of Packing &amp; Forwarding, Freight and Insurance)</b>                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      | 100                                  |                                          |              |         |
| <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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |
| (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.                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                          |      |                                      |                                          |              |         |

| 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> |     |      |                                      |                                          |              |         |
| 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-1)</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.<br>For the purpose of tender (L1 bidder evaluation) following shall be noted:<br><br>Referring to Sl no D- Supervision charges for Pump/Motor & Controller/Diesel Engine & Controller , For the purpose of Quotation, total no of 1 man days for Pump/Motor & Controller/Diesel Engine & Controller 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.<br><br>However, BHEL reserves the right<br>(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).<br>(b) To place PO for any of the Optional items with in the contract period.<br>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.<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>PY51484, 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 as mentioned in BHEL Tender Specification 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 FOAM PUMP(GEAR PUMP) WITH DRIVES ( MOTOR &amp; DIESEL ENGINE)</b><br><b>PROJECT: 1X660 MW PANKI THERMAL POWER STATION, PANKI, UTTAR PRADESH</b><br><b>CUSTOMER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED</b><br><b>CONSULTANT : M/s DEVELOPMENT CONSULTANTS PVT. LTD. AND M/s NTPC</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>A</b>                                                                          | Engine Revalidation Spares                                                                                                                                                                                                                                                     | 1                                                                                                                                                                                                                                                                                                                        | Set  |                                                |                 |         |
| <b>B</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  |                                                |                 |         |

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

|                                                                                                                                                                                                                                                    |                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <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>(CHECKLIST)</h2> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

**ANNEXURE- 4 to BHEL TENDER SPECIFICATION**

**CHECKLIST FOR OFFER FOR FOAM 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) Un-priced copy of price in attached BHEL price bid formats (Annexure-3) indicating quoted/ not quoted against each row & column.<br>e) Equipment qualification criteria / PTR / Reference Lists (Annexure-6)<br>f) Checklist as per Annexure-4<br>g) No Deviation Certificate as per (Annexure-10)<br><br><b>Datasheets in formats other than Annexure-2 shall not be reviewed.</b> |                |
| 2.    | All-important documents such as duly signed in 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><u>Further any document indicating scope of supply submitted by bidders shall not be reviewed.</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |
| 4.    | Bidder to confirm that Performance requirement, Design and construction of the offered Pump model shall be as per NFPA-20.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |
| 5.    | Bidder to confirm that Performance requirement, Design and construction of the offered Diesel Engine shall be as per NFPA-20.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 6.    | Bidder to confirm that Performance requirement, Design and construction of the offered Motor shall be NEMA MG 1, IEC 60034- 1 & NFPA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                |
| 7.    | Bidder to confirm that Motors make shall be as per NTPC approved vendor list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 8.    | Bidder to confirm that the Each Drive shall be provided with dedicated controller as per NFPA-20/NFPA-70.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
| 9.    | Bidder to submit Soft copy and hard copy of logics executed in Controller. The same is required by customer during operations for uploading the programme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |

|     |                                                                                                                                                                                                                                                                                                                                                                            |  |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 10. | Bidder to confirm that the Motor Rating Selected is as per requirement mentioned NFPA-20 and in BHEL Tender Specification.                                                                                                                                                                                                                                                 |  |
| 11. | Bidder to confirm that the Engine Rating Selected is as per requirement mentioned NFPA-20 and in BHEL Tender Specification.                                                                                                                                                                                                                                                |  |
| 12. | Bidder to confirm that Performance requirement, Design and construction of the offered Electric-Drive Controllers and Engine- Drive Controllers shall be as per NFPA-20/70 standard.                                                                                                                                                                                       |  |
| 13. | Refer Annexure-2 of Tender Specification: Datasheet of Foam Pump-Motor & Engine Datasheet. Duly filled Annexure-2 is enclosed with bidder's offer as indicated Tender Specification, Bidder to Confirm.                                                                                                                                                                    |  |
| 14. | Bidder to confirm that suitable supporting structure for Fuel tank along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                        |  |
| 15. | Bidder to confirm that suitable supporting structure for Battery along with necessary fixing arrangement included in their scope.                                                                                                                                                                                                                                          |  |
| 16. | Suitable power, control and signal cable with glands & lugs for cable between Controller, Battery, Battery charger and Diesel Engine shall be included in bidder scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                  |  |
| 17. | Bidder to provide suitable Power cable gland and lugs for motor. Cable details shall be furnished during detail engineering stage. Bidder to confirm.                                                                                                                                                                                                                      |  |
| 18. | Bidder to provide suitable canopy for each motor.<br>Bidder to confirm.                                                                                                                                                                                                                                                                                                    |  |
| 19. | Minimum instrumentations indicated in Tender Specification, bidder to include it in their scope of supply. Deviation in this is not acceptable. Bidder to Confirm.                                                                                                                                                                                                         |  |
| 20. | Bidder to consider Exhaust Piping, Silencer, Insulation, Bends, Fittings etc. as per NFPA-20. However as a minimum Bidder to consider 15 m of exhaust piping with silencer & insulation with 6 Nos. of bends 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> |  |
| 21. | Each engine shall be provided with 2 Nos. of Lead-acid plante battery units as per IS. Battery shall be sized as per NFPA-20. Bidder to Confirm.                                                                                                                                                                                                                           |  |
| 22. | Each engine shall be provided with 2 sets of battery charger units as per specification. □ Bidder to Confirm.                                                                                                                                                                                                                                                              |  |
| 23. | Coupling between pump and drives, [Motor/Engine] shall be as per NFPA-20. Bidder to Confirm.                                                                                                                                                                                                                                                                               |  |
| 24. | 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.                                                                                                                                                                                  |  |
| 25. | All auxiliary equipment required for completeness of System, If any applicable, as per NFPA-20 shall be considered in bidder's scope. Bidder to confirm. [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.                                              |  |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 26. | 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.                                                                                                                                                     |  |
| 27. | 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.                                                                                                                                                                                                                                |  |
| 28. | 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.                                                                                                                                                                                                                                                                                      |  |
| 29. | Painting schedule shall be as per Annexure-5 of Tender Specification, Bidder to Confirm.                                                                                                                                                                                                                                                                                                                                                                |  |
| 30. | <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. |  |
| 31. | Bidder to appoint TPI agency from the following on behalf of BHEL for inspection of items sourced from outside India: i. Lloyds Register of Industrial Services (LRIS), ii. Bureau Veritas (BV), iii. Det Norske Veritas (DNV), iv. Certification Engineers International Ltd. (CEIL), v. TUV Bidder to Confirm.                                                                                                                                        |  |
| 32. | Make of all the items shall be as per Annexure-8 (Sub-Vendor List). Bidder to confirm.                                                                                                                                                                                                                                                                                                                                                                  |  |
| 33. | Bidder to confirm compliance with Annexure-9, Master Document List enclosed with Tender Specification, wrt list of documents, schedule of submission.                                                                                                                                                                                                                                                                                                   |  |
| 34. | 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.                                                                                                                                                                                                                                    |  |
| 35. | 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.                                                                                                                                                                                  |  |
| 36. | 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.                                                                                                                                               |  |
| 37. | Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and 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-1         |    |
|                        |                                                                                                                                                                     |                                                                                                                                              |  | 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> |  |
|                                                                                                                                                                                                                                                                                |  |

# Annexure-5

(Customer/Consultant specification)

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

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

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

**SITE CONDITIONS**

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

**1.2 Gases, Fumes & Dust Particles**

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

**1.2.02 Dust Particles**

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

2 Indoor Locations.

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

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

**1.2.03 Special Fumes**

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

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

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

**1.3 LOCATION OF MOTOR - As required**

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

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

## 1.5 TYPE

### 1.5.1 AC Motors:

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

1.5.2 DC Motors Shunt wound.

## 1.6 VOLTAGE (NOMINAL)

### 1.6.1 LV Motors

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

### 1.6.2 MV MOTORS

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

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

### 1.6.3 HV Motors

For motors above 1500kW - eleven(11) KV

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

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

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

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

1.11 DUTY

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

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

- 1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.
- 1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.

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

#### 1.12 **SUPPLY VARIATIONS**

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

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

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

Motor shall have following capabilities as specified design ambient temperature:

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

##### 1.13.2 Low Voltage Running :

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

##### 1.13.3 Momentary Low Voltage Withstanding :

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

#### 1.14 **STARTING CAPABILITY**

##### 1.14.1 Low Voltage Starting :

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

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

- 1.14.2 Cold Motor Starting ..... Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.
- 1.14.3 Hot Motor Starting ..... Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.
- 1.14.4 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.
- 1.14.5 Break-away Starting Current ..... Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:
- 1.14.5.1 Motors above 1500 KW upto 4000kW ..... 600% without any positive tolerance except for ID Fan Motor.
- 1.14.5.2 Motors above 4000 KW ..... 450%. Not subject to any positive tolerance.
- 1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

1.14.5.3 **Starting voltage requirement**

- a) All Motors (except Mill Motors)
- 80% of rated voltage for Motors upto 4000 kW
  - 75% of rated voltage for Motors above 4000 kW
- b) For Mill Motors:
- 85% of rated voltage for Motors above 1000 kW
  - 90% of rated voltage for Motors below 1000 kW

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

1.14.5.4 **Starting Time**

- 1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
- 1.14.5.4.2 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
- 1.14.5.4.3 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.



**1.14.5.5 Torque Requirements:-**

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

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

**1.15 SAFE STALL TIME**

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

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

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

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

**1.16 CLASS OF INSULATION**

1.16.1 LV Motors ..... Class F.

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

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

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

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

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

**1.18 BUS TRANSFER WITHSTAND CAPABILITY**

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

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

**1.19 TYPE OF ENCLOSURE**

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

**1.20 METHOD OF COOLING**

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

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

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

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

1.21.02 Noise level

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

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

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

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

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

**TABLE - I**

**DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS**

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

Above 125 KW-upto 200 KW

203

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

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

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

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

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

1.22

**WINDING & INSULATION**

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

1.23

**DIRECTION OF ROTATION**

1.23.1

As needed by driven equipment.

1.23.2

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

1.23.3

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

1.24

**BEARINGS**

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

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

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

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

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

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

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

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

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

1.33 **TERMINAL BOXES**

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

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

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

1.33.2 **Main Terminal Box**

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

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

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

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

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

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

Min. fault level for MV Motors - 40 KA

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

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

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

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

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

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



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

#### 1.34.5 **For Main Terminals**

##### **LT Motors**

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

##### **HT Motors**

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

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

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

#### 1.35 **EARTHING**

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



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

1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

1.44 **TYPE TEST**

1.44.01 **HT MOTORS**

- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
- b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
- c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
- d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.

e) **LIST OF TYPE TESTS TO BE CONDUCTED**



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

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

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

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

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

1.44.02

**LT Motors**

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

1.44.03

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

1 x 660 MW – Panki Thermal Power Station

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



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

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

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

**1.45 INFORMATION WITH PROPOSAL**

1.45.1 AC Motor Data Sheet.

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

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

1.46.01 Motor Data Sheet.

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

1.46.03 Following characteristics curves:

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

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

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

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



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

## 1.47 COMMISSIONING CHECK LIST (HT MOTORS)

### A PRELIMINARY CHECKS

Check the following:

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

### B COMMISSIONING CHECKS

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

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

Check the following:

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

**B COMMISSIONING CHECKS**

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

**1.49 DC MOTOR SPECIFICATION**

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

Contractor will furnish the data in respect of DC motors.

## DATASHEET

|                                                                                                                                                                                                                                            |                                                     |                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------|
| <b>Auxiliary power supply</b>                                                                                                                                                                                                              |                                                     |                                                            |
| <b>1.1</b>                                                                                                                                                                                                                                 | <b>HV supply</b>                                    |                                                            |
|                                                                                                                                                                                                                                            | 11kV, 3 $\Phi$ , 3W, 50 Hz non effectively earthed  | Motors rated above 1500 kW                                 |
|                                                                                                                                                                                                                                            | Fault level                                         | 50 kA for 1 second                                         |
| <b>1.2</b>                                                                                                                                                                                                                                 | <b>MV supply</b>                                    |                                                            |
|                                                                                                                                                                                                                                            | 3.3kV, 3 $\Phi$ , 3W, 50 Hz non effectively earthed | Motors above 200kW upto and including 1500kW               |
|                                                                                                                                                                                                                                            | Fault level                                         | 40 kA for 1 second                                         |
| <b>1.3</b>                                                                                                                                                                                                                                 | <b>LV supply</b>                                    |                                                            |
|                                                                                                                                                                                                                                            | 415V, 3 $\Phi$ , 3W, 50 Hz effectively earthed      | Motors below and including 200kW                           |
|                                                                                                                                                                                                                                            | Fault level                                         | 50kA for 1 second                                          |
|                                                                                                                                                                                                                                            | 110V, 1 $\Phi$ , 2W, 50 Hz effectively earthed      | Lighting, space heating, AC control and protective devices |
| <b>1.4</b>                                                                                                                                                                                                                                 | <b>DC supply</b>                                    |                                                            |
|                                                                                                                                                                                                                                            | 220V, 2W, unearthed                                 | DC alarm, control and protective devices.                  |
|                                                                                                                                                                                                                                            | Fault level                                         | 25 kA for 1 second                                         |
| <b>2</b>                                                                                                                                                                                                                                   | Range of variation                                  | As indicated in the specification                          |
| <b>2.1</b>                                                                                                                                                                                                                                 | AC supply                                           |                                                            |
|                                                                                                                                                                                                                                            | voltage                                             | -----                                                      |
|                                                                                                                                                                                                                                            | Frequency                                           | -----                                                      |
|                                                                                                                                                                                                                                            | Combined voltage & frequency                        | -----                                                      |
| <b>2.2</b>                                                                                                                                                                                                                                 | DC supply                                           | 198 to 240 V                                               |
| Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance. |                                                     |                                                            |

& pressure relieving device shall be designed for the maximum design pressure of the system and shall conform to the requirements of NFPA - 2001 (latest edition) or as specified by listing authorities. Material of construction for manifolds shall be as per listed design manual and shall be hydro-tested as per design manual or at 1.5 times the maximum design pressure, whichever is higher.

- (b) Discharge nozzles along with deflector shields shall be listed for the intended use including the flow characteristics and area of coverage and quantity & design shall be such that complete quantity of gas is uniformly distributed throughout the hazard volume within the specified discharge time without disturbing the ceilings, lighting fixtures etc.
- (c) The fire detection system to be employed shall be as specified elsewhere. Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers. Power supply shall be taken from the Fire detection / alarm system panels of the respective unit/s. Required annunciations such as "Gas released", "Failure of automatic actuation" etc shall be exhibited in the fire alarm panel.
- (d) Where pilot cylinders are employed for actuation of the cylinder banks, the number of pilot cylinders shall be as per the listed design manual.
- (e) Facility for manual release of gas through push buttons shall be provided along with selection facility of "Auto/Manual" from the panel.
- (f) In addition to this, local manual release through lever operation shall also be provided near the cylinder banks.
- (g) All manual-operating devices shall be identified to the hazard they protect by fluorescent paint.
- (h) Manual abort switches shall be provided for each of the area/zone and the same shall be provided as per NFPA -2001 or as specified by listing authorities.
- (i) The gas releasing devices at cylinder outlets shall be of re-usable type after discharge at any instant.
- (j) Supervision of automatic actuation devices, power supply, manual actuation circuits, and complete wiring shall be provided through control system / panel and the healthiness shall be reported or indicated in the panel automatically. Complete control system shall be listed and approved by UL / FM / VDS / LPCB.

#### 24.4.6 Fire Water Pumps & Pump House.

- i) Three (3) nos. of vertical turbine fire water pumps with drive electrical motors and all other accessories as specified. The quantity and capacity indicated in the specification is only tentative and bidder to work out capacity and quantity based on TAC guidelines / IS 3034.

- ii) Three (3) nos. of vertical turbine fire water pumps driven with compression ignition diesel engines along with all accessories required for automatic starting of diesel engine, including fuel oil system, lub oil system etc. The quantity and capacity indicated in the specification is only tentative and bidder to work out capacity and quantity based on TAC guidelines.
- iii) Two (2) (1W +1S) vertical turbine jockey with drive motors and all other accessories as per TAC as specified elsewhere.
- iv) Two (2) nos. of horizontal centrifugal type booster pumps (One motor driven and the other diesel engine driven) for hydrant service for maintaining required pressure on higher elevations of power house and boiler building.
- v) The Selection of Spray Pump Capacity & head shall be designed on the basis of the following criteria whichever is higher.
  - a) Maximum capacity required for the largest risk area/equipment of HVW spray system

OR

Simultaneous operation of three zones of MVW spray system of cable galleries.

OR

Simultaneous operation of three zones of MVW spray system of Coal Conveyors.
- vi) Total Dynamic head of pumps shall be 105/110/120 MWC.
- vii) The Pumps shall comply with the regulations of BIS/TAC/and shall be approved by TAC accredited agency.
- viii) The fire water pump house layout shall have sufficient space for the maintenance of pumps and diesel engines. further the pump house shall be provided with a electrically operated overhead travelling type crane of capacity capable of lifting heaviest component but not less than 5 metric tones capacity.

#### **A) FIRE WATER AND JOCKEY PUMPS:-**

##### **A1 Performance Requirement**

- a) Performance requirement for the pumps shall be guided by the 'Data Sheet' enclosed in this section and TAC recommendation.
- b) Pumps shall deliver not less than 150% of rated capacity at a head of not less than 65% of total head. The shut-off head shall not exceed 140% of total head of the pump.
- c) Pump 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).

**A2 Constructional Features**

- a) The design and Testing Standards of the Pumps shall conform to IS 12469 and TAC recommendation.
- b) The pumps shall comply with the regulations of Tariff Advisory Committee (TAC) 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.
- d) Motor of all pumps shall be rated for continuous duty and shall be generously designed. The continuous motor rating shall be atleast 10% above the load demand of driven equipment at design duty point. The rating shall be such that the motor shall not be overloaded at any operating point of driven equipment from zero to full load. The rating of the drive shall in any case be not less than the power required to drive the pump at 150% of its rated discharge.

**B) DIESEL ENGINE :-**

- B.1 Performance requirement of the diesel engine shall be guided by TAC recommendations.
- B.2 The engine shall be capable of operating continuously on full load at the site conditions for a period of at least six (6) hours.
- B.3 The engine shall be naturally aspirated, super charged or turbo-charged as recommended by the manufacturer. (Ref. Fire Protection Manual by TAC).
- B.4 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 it's 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 :
- B.5 Design and construction of the diesel engine shall be guided by TAC recommendations.

**B.6 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 (2x100%). 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. Also the Battery chargers shall be 2x100%.
- c) 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.
- d) 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 electric charger is automatically disconnected and the battery is charged by engine dynamo.
- e) 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.

### B.7 Governing System

- a) The engine shall be fitted with a speed control device which 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).
  - 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.

### B.8 Fuel System

- a) The diesel engine shall run on High Speed diesel oil.

- 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 230 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.

### B.9 Lubricating Oil System

Automatic pressure lubrication shall be provided by a crankshaft driven oil pump.

### B.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/NFPA.

### B.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

## 24.4.7 **DESIGN PHILOSOPHY FOR FIRE DETECTION, ALARM, PROTECTION AND CONTROL SYSTEM.**

### 24.4.7.1 GENERAL

- a) PLC based Fire Water control panel for Fire Water Pumps located in Fire Water pump house for operation of the Fire water pressurizing and pumping system. Separate parallel redundant UPS with battery shall be provided for PLC based control system.

- b) Fire Protection, Detection and Alarm Panel shall be located in the Central Control Room. Each of the Panels shall be provided with a Operating work station with colour graphic Software and printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in each Monitor Station with facility for acknowledgement.
  - c) Fire Detection and Alarm Panel in the Central Control Room shall be provided with hardwired contacts for Group Alarms for the fire Protection, detection & Alarm system and to be connected to the DDCMIS.
  - d) One(1) No Sub Fire alarm shall be located in Coal Handling Control room to take care of alarms etc in Coal handling area.
  - e) A separate parallel redundant Uninterruptible Power Supply (UPS) unit with Battery Back up shall be provided with the Fire Alarm Panel in CCR, which shall provide Power to the Operating work station & printer with Fire alarm Panel. Technical Requirements and features of the Operating work station, printer and UPS shall be provided as per NIT.
- Bidder may also consider redundant UPS feeders in main plant UPS for OWS & printer located in CCR instead of separate UPS.
- e) Satellite Fire Alarm Panels wherein all connections from the Fire Detectors and Manual call Points of the respective areas shall be terminated.
  - f) Repeater Master Fire Alarm Panel to be located in the Fire Station. All annunciations of local Fire Detection and Alarm Panels in CCR including their respective satellite Fire Alarm panels, Fire Alarm Panel in CHP and Grouped Annunciations etc shall also be made available in the Master Fire Alarm Panel.
  - g) This panel is to be provided with an operating work station with colour graphic software and printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in the Monitor Station with facility for acknowledgement.
  - h) A parallel redundant Uninterruptible Power Supply (UPS) unit with Battery Back up shall be provided with the Master Fire Alarm Panel which shall provide Power to the Operating work station & printer with Fire alarm Panel. Technical Requirements and features of the Operating work station, printer and UPS are provided in the Vol V of the Specification.
  - i) All Fire protection, Detection and Alarm Panels in CCR, CHP, Satellite Fire Alarm Panels and Repeater Master Fire Alarm Panel in Fire Station shall be integrated through Dual Redundant Optical Fibre Data Highway connected in Ring Main Topology. The technical requirements of such FO based communication cable are elaborated in Volume V of the specification.

- j) Two (2) sets (1 working & 1 standby, 100% capacity each) of 24 Volt (2x12V) Automotive type battery with charger for each diesel engine driven fire water pumps primarily for starting the engine.
- k) Two (2) sets (1 working & 1 standby, 100% capacity each) of 24 Volt sealed type maintenance free lead-acid battery with charger for each Satellite fire alarm panel, Fire Detection and Alarm panels in CCR, CHP, Satellite Fire Alarm Panels and Repeater Master Fire Alarm Panel in Fire Station.
- l) Supply, laying and connection of FRLS power, control and instrumentation cables required for complete fire protection system and Fire survival cables (950°C. for 3 hours) for CHP area.
- m) Adequate no. of Back-lit maintained type emergency exit signs as per TAC.
- n) Emergency Voice Communication System, adequate number of fireman's telephones and speakers. Speakers shall be provided in strategic locations throughout the Plant. Pre recorded voice messages shall be sounded through these Speakers to alert the people. Telephone set shall be provided in each Fire Alarm Panel. As minimum, Speakers shall be provided in Central Control Room, Coal and Ash Handling Plants, DM Water Plant, CW Pump House.

The Fire Protection, detection and Alarm System shall comply with NFPA - 72/72E and IS: 2189 standards. The Fire protection, detection, alarm and Control System shall consist of various type detectors, Control Cabling, Fire Alarm Panels, Central Monitoring station, repeater Panels, PLC control Panels and Local Panels(For Deluge Valves etc).

- a) The fire Alarm, protection and Detection system shall be hot redundant microprocessor based, analogue addressable type.
- b) Selection of temperature rating of heat detectors shall be based upon maximum ambient temperature of about 50°C for outdoor equipments ( Like Transformers, boiler burner fronts, fuel oil tanks etc) and about 40°C for indoor equipments like Coal conveyors, Cable galleries, Fuel oil Pump House etc.

**Fire detection and alarm System shall cover the following area & system :-**

- a) Multi sensor type Smoke detection System.
  - All Switchgear/MCC/Control rooms of Main Plant Building, ESP, switchyard control room building, CHP Control room, APH Control room various auxiliary building like ash handling system, compressed air system, CW/ACW system, condensate polishing plant, water treatment plant, Pump Houses, Service, Admin building, Battery room etc.
  - Below false ceiling area of all air conditioned rooms in main plant building, service building, ESP building, various control rooms of auxiliary buildings etc.

- b) Multi criteria type smoke detectors for above false ceiling for all air conditioned areas.
- c) However combination of both multisensor and photoelectric smoke detectors for above and below false ceiling of inert gas protected areas and various cable galleries protected by MVW Spray System.
- d) Linear Heat sensing Cable (Digital type) detection system for coal conveyors, and cable galleries covered under MVW Spray Systems.
- e) Quartzoid Bulb heat detection system for equipments protected by HVW Spray system, LDO/HFO, pump House etc protected by MVW Spray System.
- f) Probe type heat detectors for Fuel Oil HFO and LDO Tanks.
- g) 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. The heat detectors shall be suitably mounted on fire water pipes covering an open area.
  - Battery and battery charger rooms.
  - Oil filled type L.T. Transformers (up to and including 2500 KVA rating) However, no oil filled L.T. Transformer has been envisaged inside power house.
  - Dry type L.T. Transformers located anywhere in the plant area.
  - Batteries & UPS rooms.
  - Pantry & Canteen area.
- h) PLC based Local Fire Water control panel for Fire Water Pumps located in F.W pump house for operation of the Fire water pressurizing and pumping system. This shall be connected to DDCIMS in Main Control room thru fiber optic cables.
- i) Main Fire Detection, Protection and Alarm Panel for each Unit to be located in the Central Control Room in Power House. Each of the Panels shall be provided with a operating work station with complete Software and A4 sized B/W printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in each Monitor Station with facility for acknowledgement.
- j) Fire Detection and Alarm Panel in the Central Control Room shall be provided with hardwired contacts for Group Alarms for the fire detection system and to be connected to the DDCMIS of the respective unit.
- k) All connections from the Fire Detectors and Manual call Points of the respective areas shall be terminated to their respective Fire Alarm Panel.
- l) Repeater Fire Alarm Panel to be located in the Fire Station. All annunciations of local Fire Detection and Alarm Panels in CCR including their respective satellite panels, Fire Alarm Panel in CHP and Grouped Annunciations etc shall also be made available in the Master Fire Alarm Panel as well as in repeater panel.

- m) Main/Sub Fire alarm panel is to be provided with a operating work station with colour graphic software and A4 sized B/W printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in the Monitor Station with facility for acknowledgement.
- n) A parallel redundant Uninterruptible Power Supply (UPS) unit with suitable Battery Back up shall be provided with the Master Fire Alarm Panel which shall provide Power to the operating work station & printer of the Panel. Technical Requirements and features of the OWS, printer and UPS are provided in the Vol V of the Specification.
- o) All Fire Detection and Alarm Panels in CCR, CHP, and Repeater Fire Alarm Panel in Fire Station shall be integrated through Dual Redundant Optical Fibre Data Highway connected in Ring Main Topology. The technical requirement of such FO based communication cable are elaborated in Vol. V of the specification.
- p) PLC based panel at fire water pump house, electronic based panel at foam and booster pump house shall indicate the status of each pump, system pressure, operation system, failure of starting of pumps, healthiness & failure of batteries/ chargers, main supply, low level of fuel oil of diesel engines, tripping of pumps, low level / very low level of water level in the water supply system, status of batteries & chargers of panels and diesel engines etc. Alarms from these panels shall also be available to operator at fire alarm addressable panels, central monitoring station and DDCMIS.
- q) Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (2x12V) Automotive type Ni-Cd battery with charger for each diesel engine driven fire water pumps primarily for starting the engine .
- r) Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (12x2V) sealed type maintenance free lead-acid battery with charger for each Satellite fire alarm panel, Fire Detection and Alarm panels in CCR, CHP and Master Fire Alarm Panel in Fire Station.
- s) Supply, laying and connection of FRLS power, control and instrumentation cables required for complete fire protection system and Fire survival cables (950°C. for 3 hours) for CHP area.
- t) Adequate no. of Back-lit maintained type emergency exit signs as per TAC shall be provided in all staircases of the building coming under plant battery limit.
- u) Emergency Voice Communication System, adequate number of fireman's telephones and speakers. Speakers shall be provided in strategic locations throughout the Plant. Pre recorded voice messages shall be sounded through these Speakers to alert the people. Telephone set shall be provided in each Fire Alarm Panel. As minimum, Speakers shall be provided in Central Control Room, Coal and Ash Handling Plants, DM Water Plant, CW Pump House.

- v) The panel at coal handling plant control room shall exhibit alarms from detection and protection from coal handling plant and all other auxiliary building/areas. Further, all panels shall also be hooked-up with Fire alarm panel at Central Control room for alarm purpose.
- w) The central monitoring station to be located at Central Control Room and coal handling plant control room and shall cover the fire detection and protection system of the complete (all the areas) plant. This shall give audio-visual annunciations for fire in each of the risk area / equipment/ status of the fire protection system as well as system operator open /short circuit status of detector or control cabling etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system.
- x) Alarms from all the fire alarm addressable panels shall be repeated simultaneously in repeater panel at Fire station.
- y) Dual action type Manual Call Points shall be provided at strategic locations at indoor and outdoor (preferably in Coal handling plant).
- z) Sounder cum flashers shall be required at the exit gates along with the hooters/sounders along with Manual Call points. With each Manual Call Point, hooter/Sounder flashers shall be considered. The distance between consecutive MCP and Hooter shall be in such fashion that a person should not travel more than 30 mtr distance from the nearest one.
- aa) Response indicators shall be employed for the showing the status of the detectors placing above false ceiling.
- ab) Bidder shall refer Vol. V for complete C & I requirements of Fire Detection, protection & Alarm system.
- ac) All instruments, detectors, cables and control equipments etc shall ensure high availability, high reliability, low down time and ease of maintenance.
- ad) Complete Fire protection, detection & Alarm system shall be designed in such a way that any failure in cable, detector or any component used in system, wire break, short circuit etc will not impact on the system and the Fire protection, detection & Alarm system shall be available 100% all the time round the year.

#### 24.4.7.2 DESIGN:-

##### **1.0 Detectors (Microprocessor Based)**

- a) Detectors shall be intelligent analogue addressable type. Detectors shall be housed or mounted in suitable enclosures in such a way that their performance is in no way affected. Special maintenance procedures, if any, required for the satisfactory operation of the detectors shall be clearly described.
- b) In case detectors having electrical contact signal output on sensing fire, it shall be noted that the contact shall be "NC" type so that under fire conditions, this contact will open to initiate fire alarm system (fail safe type).

- ### A. Multi Criteria Smoke Detectors

- a) The multi criteria smoke detectors shall be capable of sensing the fire in the incipient or smoldering stage itself, long before the fire matures to a visible flame. For achieving this requirement, the detector shall be capable of sensing visible combustion gases (in the form of smoke) or invisible combustion gases, which are the only clues for a long time in smoldering fires.
- b) The detectors shall be sensitive to very low smoke densities of the order of 0.05 gm/cum.
- c) The detectors shall be of Multisensor type with a combination of photo electric and heat sensing elements. The multicriteria smoke detector provides photo electric sensing and heat sensing combined in a single



sensor/base assembly. The multisensor base provides two sequentially addressable points, automatically assigned with one address selection.

- d) The sensitivity of multicriteria smoke detectors shall be selected depending upon the environmental condition.
- e) For further specification of multicriteria smoke detector, data sheet shall be referred to.
- f) The design Coverage area for smoke detectors to be considered shall not exceed 25m<sup>2</sup> for A/C area per each detector and 35-40 m<sup>2</sup> for non A/C areas.

**B. Rate-of-Rise and Fixed Temperature Heat Detector (IC Type)**

- a) The detector shall be solid thermal detector.
- b) It shall operate on electronic-principle to provide precise fire detection.
- c) The detector shall be of integrated circuit design enclosed in a robust moulded base.
- d) It shall be completely moisture proof and air tight with exposed metal part specially treated to allow the device to be used in particularly corrosive atmospheres.
- e) The detector should work on rate-of-rise and fixed temperature modes of operation.
- f) It shall have no moving mechanical parts.
- g) The detector shall be either surface mounted or with the body concealed above the ceiling and only the detecting element in view.
- h) The rate-of-rise detector shall function when the rate of temperature increase exceeds a pre-determined value, around 7 to 8 Deg C per min. This detector shall be designed to compensate with the normal changes in ambient temperature, less than 6.7 Deg C per min., which are expected under non-fire conditions.
- i) For further details, data sheet shall be referred to.
- j) All the detectors shall comply style-7 fashion as per NFPA-72 standard.
- k) Inbuilt indicating lamp shall be provided to indicate operation of the detector.

**C. Linear Heat Sensing Cable**

- a) Linear Heat sensing cable shall be SS braided digital type (For Coal conveyors for Cable galleries/ spreader rooms. All cable shall be SS braided.

**D. Frangible (Quartzoid) Bulb Type Detector**

- a) In frangible bulb type detectors a small amount of gas along with heat sensitive liquid (coloured) is entrapped and hermetically sealed. This detector shall generally be mounted on the pressurized water line which forms a ring around the equipment to be protected. When the surrounding temperature rises more than the rated temperature of the detector, the gas inside the detector shall expand and as a result the quartzoid bulb shall collapse releasing water and consequently pressure in the water line shall fall sharply. This fall in pressure will give signal/annunciation in the Panel.
- b) The frangible bulb shall be capable of withstanding the hydraulic test pressure (19 Kg/Cm<sup>2</sup> g) in normal practice.
- c) Type and make of frangible bulb shall be of Owner's choice /approval.
- d) For further details data sheet shall be referred to.

#### **E. Infra red Spark/Ember Detector**

- a) The detector must respond satisfactorily even when the lens, through which the detection is sensed are covered with coal dust or oily dust substance.
- b) The detectors shall be designed to work satisfactorily in the event of vibration in any axis.
- c) To prevent false alarms, the detectors shall be provided with purge air facility to keep the lines clean.
- d) Facility for remote response indication shall be envisaged in each detector.

#### **F. Manual Call System of Fire Alarm (Intelligent Addressable Type)**

- a) The design shall be dual action type with the provision of key resetting.
- b) Dual-color LED blinking for annunciation.
- c) The MCP shall be made of M.S/ABS body.
- d) The manual call points shall be provided at each entry & exit point of control rooms, UPS rooms, battery rooms, and other critical & mandatory locations specified else where in the specification.
- e) The manual call point enclosure shall be completely dust, weather and vermin proof. The housing of the electronic circuitry shall have minimum IP 65 protection. The complete unit shall be suitable for wall/column mounting with necessary mounting accessories.
- f) Clear inscription reading (in English) "FIRE ALARM - IN CASE OF FIRE PUSH" shall be provided for each manual call point unit, either on the enclosure or on a separate metal plate mounted behind the glass cover. The metal plate for inscription shall not tarnish under the atmospheric conditions
- g) Type of manual call point shall be intelligent Addressable Analog type.
- h) 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.
- i) The Manual Pull station shall be addressable type, the address and the location of the same shall be annunciated in the panels on operation.

**G. Power Module**

- a) The Power Module shall be provided with AC to DC conversion circuits and the battery charger circuits. The panel which requires more than 16 Amp, A.C. power supply shall be suitable to receive 415 Volts  $\pm 10\%$ , 3-Phase, 50 Hz  $\pm 5\%$ , 3-wire power supply through MCB. Other panels having requirement of equal to and less than 16 Amp., A.C. power supply shall be suitable to receive, 240 Volt  $\pm 10\%$ , single phase, 50 Hz  $\pm 5\%$ , phase and neutral, through MCB.
- b) The panel shall have in-built stabilized power supply unit for its electronic circuitry which rectifies A.C. power supply to D.C. for system operation. Power supply to the detectors, manual call points, external hooters etc. shall be provided in the panel.
- c) The automatic with manual over-ride change over inclusive of all metering, control, indication and interlock system shall be provided.
- d) Parallel redundant (2 x 100% rating) Regulated power supply modules shall be used for operation of various components / cards. LED indications for system ON and blow fuses shall be provided on the Facia of Power Module.

**H. Monitor Module**

- a) The monitor module shall be provided with all circuits which shall be able to monitor the various conditions / status of power supply section continuously. The monitor module shall be plug-in type.

**I. Control Module**

- a) The Control Module shall be provided for hooking-up with Power Module, Monitor Module and Zone Module and for proper controlling of system of Fire Protection Zonal System. The Control Module shall be plug-in type.

**J. Zone Module**

- a) Zone Module provided shall be of intelligible and addressable type. The zone module shall function as the interface between the various types of intelligent addressable analogue type fire detectors connected in the field and the panel circuits. Zone module shall comprise of necessary circuits for continuously monitoring the detectors, line cabling, the circuit for open, short and fire condition with audio-visual alarm. Facility for testing and isolation through push button shall be provided for zone module to simulate the open and short circuit of the cable connected between detector and the panel and fire condition with audio-visual alarm. Audio-visual alarm for each zone module in case of withdrawal or taking out of zone module from the connected system shall be provided. Zone module shall be designed in such a way that even after detection of fire from one detector located in a zone, the same zone shall be in operation for detecting fire. All the Zonal Fire Panels shall be networked through Fibre Optic Link with the Main Fire Detection and Alarm panel in CCR.

Note : 20% spare wired channel shall be provided in each module.

**K) Realy Modules**

- i) No of contacts per relay shall be 2 SPDT or DPDT.
- ii) 20% spare wired relay shall be provided in each relay module.
- iii) The relay Module shall be plug-in type.

**L) Loop Sounder/Hooter**

- i) Loop Sounder/Hooters shall be intelligent addressable and electronic type.
- ii.) Loop sounder/hooters shall be provided with each Fire alarm panel, section indicating panel, Satellite Fire Alarm Panels & Repeater panel.
- iii.) The system shall have provision to annunciate any one or all the loopsounder/hooters on any given condition.
- iv.) The sound intensioty/volume shall be more than 85 dB at one meter distance and 5 dB above the back groud noise/sound at one meter distance.
- v.) Colour of case shall be red.
- vi.) Pitch, tone & volume of sound shall be adjustable.
- vii.) Type of tone shall be selectable. (Minimum 4 types of tones shall be provided).

**2.0 Fire Panels****A. Satellite Fire Protection, Detection & Alarm Panels**

- i) Satellite fire panels will be used to cater for the fire detection, deluge valve operation, associated annunciations system and power supply distribution network for the Fire Protection system. These panels shall be based on intelligent addressable Microprocessor based technology. These panels shall be strategically located in different areas of the Power Plant considering zone wise fire detection and fire fighting system.
- ii) The system shall be operable from each fire detector network, automatic deluge valve right upto each local zonal fire panels, Manual Call Points provided in the area /equipment shall also be hooked up with such type of Local Fire Panels.
- iii) Number of Satellite Fire Panels will be minimum as indicated in Vol V of specification and as finalized during detailed engineering. Any more no. of panels as required shall also be provided.

**B) Fire Detection, Alarm & Protection Panels in Central Control Room.**

- i) The Fire Detection and Alarm Panel for the unit shall be based on intelligent addressable redundant microprocessor based technology and will be used to hook up with each of the Satellite Fire Alarm panels. The Panel with its operating work station, Monitor, printer and Peripheral devices shall

detect, display and annunciate electrical fault (open or short circuit), individual detector wise and Group Zone wise Fire Annunciation Satellite fire panels. in addition to monitoring its own detection system. The Fire Detection and Alarm Panel shall also supervise, monitor and annunciate the condition of the circuitry of the fire detection system through Satellite fire panels.

- ii) The monitor of the fire detection and alarm panels in CCR shall be located on the operator's control desk of the respective units in the Central control Room.
- iii) One number of Fire Detection and Alarm Panel complete with all accessories as described above and other items to make the installation complete is to be provided for the unit.
- iv) Fire Detection and Alarm Panel shall have microprocessor based annunciation system. It will supervise; monitor the detection circuit through the Satellite Fire Panels.
- v) Fire Detection and Alarm Panel shall detect and display both Fault and Fire alarm from each Satellite Fire Panels. The Fire Panels shall supervise, monitor and annunciate the condition of the entire circuitry up to the detectors through Satellite Fire Panels.
- vi) The Fire Detection and Alarm Panel shall be indoor, air insulated, metal clad, floor/Wall mounting type.

### C) Repeater Alarm Panel in Fire Station

- i) The Repeater Fire Alarm Panel used to repeat, monitor, supervise and annunciate whatever fire and fault alarms annunciations coming in the fire detection and alarm panel of central control room. This panel shall also monitor supervise the circuitry between the Fire Alarm Panels in CCR, Sub Fire alarm panel in CHP. The repeater panel shall be located in the Plant Fire Station.
- ii) One number of Repeater Fire Panel complete with all hardware and accessories and requisite software is to be provided, in the Fire Station.

### D) Local Fire Water Control Panel (PLC Based)

The Local Control Panels shall be provided for the following services:

- i) Auto manual control, interlock, indication supervision and HW annunciation for Fire Fighting Equipment (Fire Pumps, Jockey Pumps etc.) located inside the FW Pump House. Complete operation of the Diesel engine driven pumps shall also be performed from this panel.

**The following feature shall also be provided in Local Fire Panels, Main Fire Panels and Repeater Panel :**

- i) Actuation of any of above push buttons shall activate the corresponding Audio/Visual indications.
- ii) External audio-alarms (if any) shall not come on during the testing period.

- iii) No relay/contactors shall get energised during TESTING PERIOD to avoid spurious tripping / actuation / simulation of alarms in the associated equipment.
- iv) The performance and characteristics of audio-visual annunciation system shall conform to BS, NFPA codes.

**Local Control Panel for Fire Water System / Diesel Engine Driven Pumps and other Fire Protection Equipment located Fire Water Pump House and a local control panel for electric & diesel engine driven Booster pump.**

- i) Local Control Panel for the service called for shall be indoor, air insulated, metal clad, floor or wall or column mounting type. Type of mounting shall be determined by the Bidder depending upon layout convenience and size of the panel.
- ii) The panel shall be fabricated out of 2 mm thick CRCA sheets. Degree of protection of the panel enclosure shall be IP-54. Lockable front door with proper gasketing shall be provided.
- iii) Power module shall be provided with parallel redundant AC to DC conversion circuits and the battery charger circuits. The panel shall have in-built parallel redundant stabilizer power supply unit for its electronic circuits which rectifies AC power supply to 24 volt DC for system operation.
- iv) The automatic with manual over-ride changeover inclusive of all metering, control, indication and interlock system shall be provided.
- vi) All controls, interlocks, indications and annunciation system shall be provided for safe and trouble-free operation of the Plant / equipment supplied.

**The Panel shall be provided with the following features as minimum:**

- One (1) Auto-Start Control Section for auto start of electric driven fire pumps, jockey pumps and one (1) no. auto-start control section for diesel engine driven pumps shall be provided inclusive of following gadgets as minimum :
- Auto and Manual Selector Switch for each electrical driven fire pump, jockey pump and air compressor (if applicable).
- Manual Start / Stop Push Button for each drive.
- Indicating Lamp showing power – ON
- Indicating Lamp showing power – ON / OFF
- Engine r.p.m. Indicator
- Lubricating oil pressure indicator

- Engine Cooling Water temperature – “in and out” indicator.
- Differential Pressure Indicator across strainer.
- Voltmeter / Ammeter in Battery Charging circuit. Ammeter for each Electrical motor.
- Hardware for diesel engine driven pump's control system.
- Any other instrumentation and control required as per system demand and as per design criteria & guidelines specified in C&I part, Vol. V.
- All annunciations as listed elsewhere and as required for safe and trouble-free operation of the plant / equipment supplied.
- The operation of control panel for Booster Pumps located in the Booster Pump House shall be similar to that of FW pump Panel.

#### Specific Requirements for Local Fire Panels

- Local Fire panels shall be indoor, air insulated, metal clad, floor, wall or column mounted type. Type of mounting shall be determined by the Bidder depending upon layout convenience, type, rating and duty involved in each category of panels.
- Each local fire panel shall be fabricated out of 2 mm thick CRCA sheets. Degree of protection of the panel enclosure shall be IP-54. However the hooter box to be mounted to the top of each panel shall have degree of protection IP-40.
- The front door shall be provided with either toughened glass or acrylic transparent sheet over the lockable full door with proper good quality of gasketing arrangement and with proper lock or equivalent so as to maintain degree of protection of IP-54.
- The components, which are to be fixed inside the cubicle, shall be so located on separate swing compartment in such a way that component and zone modules are clearly visible through glass or acrylic transparent sheet.
- The panel shall be designed in a truly modular concept with each zone represented by a module in order to minimize the wiring inside the panel and to minimize the breakdown time of the system.
- Each intelligent addressable local fire panel shall be capable of operating the intelligent addressable detectors and provided with the following plug-in type modules.
- Panel shall be designed on solid-state circuitry with provision of zone printed circuit cards, which shall be coated, for prevention against corrosion with suitable gold plated connectors for proper contacts. Gold plating shall be in the order of 4 to 6 microns.
- System of fire alarm shall be based on two-wire circuit system. Number of zones per panel shall be provided as per actual system requirement.

Each zone card shall be independent. Repetition of Fire Alarm and "Open and Short Circuit" of cables shall be provided in the panel.

- "Fire Detection Operated" signal shall be generated in the panel and shall be provided in the panel for hook-up with Owner's air-conditioning system, ventilation system, coal conveying system etc. The panel shall have provision for hook-up with external hooter, siren also.
- The panel shall have Ammeter and Voltmeter for 24 V D.C. System.
- UPS 230 Volts Volts Bus System shall be provided in the panel for solenoid operated valve required for Fire Fighting System in Coal Conveyors.
- All the Fire and Fault indications / alarms for the various zones and / or groups of zones shall be made available as electrically potential-free contact of adequate rating at the terminal strips of the Local Fire Panel for repetition of the same at Repeater Panel and Main Fire Panels.
- For each deluge valve, module shall be provided in panel in similar to Fire Detection System with the audio-visual alarm for (a) Detector circuit water pressure low, (b) Deluge valve operated (i.e. FIRE).
- The coal conveyor system shall be equipped with solenoid type Deluge Valve (SDV) to be operated automatically through fire detection system. Each SDV shall be provided with limit switch contacts to indicate actual operation of the solenoid operated valve in the panel. Since these connecting cables are to be run with other cables, the signal interference shall be avoided.

### 3. Microprocessor based Fire Alarm System

Bidder shall quote for a microprocessor based system to achieve the functional requirements as indicated above.

#### System Required

##### A) Panel System

- i) The 100% hot standby redundant micro processor based fire detection and fire alarm system shall be designed such as to have built in redundancy to ensure availability at all times.
- ii) The system shall basically comprise of the followings:
  - Fire alarm panels housing the main processor units and plug in modules.
  - Addressable type detectors shall be hooked up to the panel.
  - Main and standby power supply units.
  - Operating terminals.
  - Printer.

- iii) The control unit shall be of modular design, by means of plug in cards along with future expansion facility, exact tailoring of detector zones and control outputs to the actuation devices as required.
- iv) The control unit shall be micro processor based and controlled by a programme contained in nonvolatile memory (EPROM).
- v) Licensed version of Run and Edit mode of Software for the Fire Alarm panels, PLC System and Human Machine Interface System shall be provided.
- vi) The control unit shall be suitable for accepting inputs from addressable type detector. It shall also have the facility to monitor the contact inputs.
- vii) All the detection circuits shall be monitored against open circuit, short circuit and ground faults. For any malfunction in any detection line the control unit shall initiate a trouble signal for that detection line.

Further, the following criteria shall also be met.

- Fault in one detection line shall not affect the functioning of other detection lines.
  - A single open circuit, short circuit or ground fault shall not inhibit the detection capability of the detection circuit. Suitable circuitry / modules shall be provided.
  - The control unit shall pin point the location of fault for ease of maintenance.
  - The alarm display unit, in the event of fire shall indicate the zone no. and zone description. It shall be possible to define the zones through software.
- viii) The control unit shall be capable to process and evaluate incoming signals from addressable devices such as automatic heat/smoke detectors, manual call points etc. via four wire line circuits. The control unit shall be compatible with the detection line impedances.
  - ix) Each addressable line module shall have its own microprocessor-based circuit, working independently from the central processor unit located in the control unit.
  - x) In the event of an alarm or a fault condition it shall be possible to determine the exact device address at the control unit by means of numerical display. The device address shall comprise of the line number, device number and zone number.
  - xi) The detector shall be exchangeable without any change of programme.
  - xii) It is Bidder's responsibility to include required number of zone modules for the addressable detector.
  - xiii) Any special type of cable required for the detection system shall be provided by the Bidder.

- xiv) Provision for a Remote Electronic Hooter with intelligent Control Module shall be made and the Hooter Unit shall be placed in a convenient location to draw attention to the people in the locality.

### B) Detector System

- i) Selection of detectors as per the requirements for that area and indicated previously. However some general criteria are elaborated additionally below for Bidder's guidance.
- ii) Selection of type and number of detectors shall be based on type of combustible and ignition source, type of environment and type of risks involve. The detector shall determine whether a fire condition exists in the room / area where the detector is located. In case of fire, the audio-visual fire alarm will be generated at Central Control Room as well as initiate signal to operate a Hooter located at convenient place in the Power House Building, along with repeat display at fire alarm panel in Fire Station.
- iii) Bidder shall consider area, ceiling height and type of ceiling construction for selection of optimum detector number and their placement. Other factors like ventilation, ambient temperature, radiation etc. are also to be taken into consideration.
- iv) Guidelines in various standards such as NFPA-72, IS:2189, AERB standards etc. shall be followed. Detectors shall comply style-7 of NFPA.
- v) Multi criteria smoke/heat detectors shall be intelligent analogue addressable type and shall have bi directional communication capability with the control panel. The accessory if required for the programming of the detector's address shall be provided. Further it shall be possible to change the detector sensitivity, calibration and identification from the control panel.

### C) Additional Features

Followings are the additional features required :

- i) A Operating work station with a keyboard and a A4 sized colored Laser printer. The monitor is essentially a 24 inch LED colour monitor which shall be hooked up to the main fire alarm control panels and shall display the alarm, prewarning, faults, system diagnostics and data logging system. A print of the data logged can be taken on demand.
- ii) All the panels shall be standalone floor mounted type and as per design criteria & guidelines specified in C&I part, Vol. V

#### 24.4.7.4 OPERATIONAL PHILOSOPHY & TECHNICAL REQUIREMENT:-

Each of the Addressable Fire Alarm panel shall be able to communicate with one another as well as with repeater annunciation panel and PLC based control panel located IN Fire Water Pump House. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location. Facility to operate

booster pumps, foam system pumps and fire water pump house shall be provided from OWS based monitoring station.

At least 10% spare loop shall be provided in each of the addressable type fire alarm panel located in unit control room and in CHP control room with complete loop card and all other accessories so that OWNER can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by OWNER in future.

Fire system (as a whole including PLC control systems) shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two-way transfer of signals for the purposed of information sharing. The information shall be made available though on Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engg. All required plant data shall be transferred to /from through the ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering.

#### **System Functional Requirement**

The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions:

1. System self monitoring and fault signaling.
2. Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate hooter / sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode.
3. Initiate control functions like stoppage of conveyor, closure of fire doors, shutdown of draft fans, air-conditioning and ventilation plant/ equipment, opening smoke extraction vents, switching on smoke extraction equipment, emergency lighting etc.
4. Triggering stationary extinguishing systems such as clean agent system.
5. Supervising of unauthorised removal of a detector head from its base and giving a fault alarm on the control panel.
6. Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring.
7. Supervising by a separate annunciation window, changeover from mains supply to battery supply. "Mains On" indication shall be continuously on, as long as the main supply is available.
8. Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel

9. The control unit shall contain all the systems main switches lamps and fuses. Switches and lamps shall be easily identified even in closed casings.
10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and shortcircuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for 'fault' alarms and 'fire' alarms.
11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. **For achieving this if any additional hardware is required like relays, power supply and cables, the same shall be provided.**

**Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements:**

- i. Each of the system shall support analog addressable detectors of all types, non-addressable type detectors / devices along with its addressable interface units / modules, Video display units etc.
- ii. Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.
- iii. Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.
- iv. The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.
- v. Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.
- vi. The system shall be able to recognize and indicate and alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.
- vii. The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a OWS for program editing. The software shall eligible Owner to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.

- viii. The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.
- ix. The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.
- x. Software logic modules and system database shall be programmable using a windows compatible program on OWS. It shall be possible to program or edit the system database off site after down loading from the panel.
- xi. All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel.
- xii. In an alarm or trouble condition the following shall occur on the monitoring station:
  - 1. Sound an audible.
  - 2. Write details of the actuation to a system log file on the OWS.
  - 3. Print the details of the actuation to the system printer.
  - 4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.
- xiii. System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.

#### **Panel Display Requirements.**

System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.

- a. The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.
- b. As a minimum an LED display for "Alarm", "Audible Silenced", "Supervisory", "Trouble", "Security", "Power On", And "Partial System Disabled".
- c. Touch activated membrane switches for "Alarm Acknowledge", "Audible Silence", "Supervisory Acknowledge", "Security Acknowledge", "Reset", "Display Hold", And "Display Next".
- d. All membrane switches shall be tactile with audible feedback when pressed.

**SYSTEM SOFTWARE REQUIREMENTS**

- i) The software shall control the operation, function and display of the graphic system and provide for automatic boot up and run from the hard disk drive of the computer.
- ii) All project specifics actuating device programming shall be capable of being carried out on site via password access.
- iii) The system shall monitor all alarm, supervisory; trouble and security conditions detected by the fire alarm control panel and provide separate disk based files, for each condition. These logs may be enabled, disabled, or cleared with password access. This log information is not to be lost upon power failure or fire alarm control panel reset. A utility file shall be provided to sort the log data by date or by device and display this information either on the screen or the system printer.
- iv) Selective memory storage up to 800 events, shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.
  - a. Software shall allow selection of events to be logged, including; inputs as alarms, troubles, supervisors, securities, status changes and device verification; out puts, as audible control and output activation; action, as reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.
  - b. Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data. The system shall be programmable circular logging, assuring that at least the last 400 events will always be stored in non-volatile memory.
- v) Software has driven logic for adjusting the alarm threshold windows on detectors to compensate for accumulating contamination and keep detector response sensitivity constant. The software shall compensate for either oversensitized or desensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for cleaning.
  - a. Values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 sec of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed.

When the full data history is active all devices shall be checked and any active alarms displayed.

- b. The control panel shall place each detector in the system in an alarm condition, transparent to the system user, every twenty-four hours as a dynamic check of the accuracy of the alarm threshold setting. Upon reception of the alarm report, the system detector shall be restored to its pretest state.
- c. The system shall be capable of monitoring the stage of detectors and displaying a message when a detector is approaching the limits of adjustment as a result of contaminates. A second message

shall be displayed when the detector reaches the limits of adjustment due to these contaminate.

- d. The system shall be capable of recognizing that a detector has been cleaned, initiating a series of tests to determine if the cleaning was successful and display a detector cleaned message, readjusting that detectors normal sensitivity setting reference.
- vi) When an alarm or trouble is registered at the fire alarm control panel the graphics system shall display the first screen image for the first actuated device. The system shall be capable of zooming in for further information if required. At all times when in the alarm or trouble mode the fire control panel status i.e. number of current alarms and or troubles is to be displayed on the graphics screen.

### Detection System for Coal Conveyors

- a. The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/ supplier. The mounting arrangement shall be designed such a way that the same shall not hinder the normal operation and maintenance. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house.
- b. The detection zone/loop divisions of LHSC system shall match with the MVW spray system.
- c. Wet type QB detection system shall also be employed in addition to LHS Cable.
- d. Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site.
- e. The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel.
- f. The infra red type (IR) detectors shall be suitable for detecting moving fires in coal conveyors.
- g. The IR detector shall stop the conveyor upon detection of fire and give audiovisual annunciation locally and in fire alarm panel.
- h. The IR detector shall be outdoor type weather proof and shall be able to function continuously in heavily coal-dust prone atmosphere without regular maintenance.
- i. The IR detector shall be designed to reject deceptive phenomenon such as electric arc, heaters, artificial light sources (HPSV/LPSV/incandescent lamps etc.) Sunlight etc. while retaining the inherent detection characteristics.
- j. Each of the IR detectors shall be provided with its own purging arrangement using blowers, hoses, etc and required power supply shall be

derived from the fire alarm panel. Alternatively, bidder to each of the IR detector shall be provided by the bidder.

- k. The performance of the proposed IR detector model for detecting moving fires shall be demonstrated to Owner as per test procedure acceptable to Owner before supply of the same at site. Such demonstration test shall be conducted in a typical coal conveyor test set up at works or in a plant.
- l. Min two (2) Nos Solar Blind Infra-red detectors with inbuilt air purging unit as per specification shall be used in each coal conveyor gallery and tunnel for detection of moving fire.

#### Detection System of Cable Galleries

- a. In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from smoke (after cross zoning) detection system. Apart from the automatic operation of spray system in the detected zone the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously.
- b. LHSC detector shall run in a zig-zag fashion (with an included angle of minimum 90 degree atleast) in each of the top tray, bottom tray and in every alternate trays. Mounting arrangement of LHSC detector shall be as per recommendation/proven practice of manufacturer.
- c. The detection zone/loop divisions shall match with MVW spray zones.

#### 24.4.8 Control and Instrumentation

For technical features and requirements of the control and instrumentation items including Field instrument, Panels and Panel mounted instruments, annunciators, PLC and other hardware and peripherals under scope of supply for the Fire water system, Bidder shall refer the relevant clauses of the Volume V – Instrumentation & Control Works

##### 24.4.8.1 Battery and Battery Charger

##### 24.4.8.1.1 Battery

- a) Battery to be located in FW 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 × 12 V-2x100%) & Battery and Battery Charger unit(2x100%)
- b) Satellite Fire Panels are located strategically in the power. All controls, interlock, indication, annunciation system etc. for Fire Detection system shall have power supply from 24V (2x12V) Battery and Battery charger Unit. The Battery for each Satellite Fire Panel compatible with UL standard shall be located in the bottom portion of the same panel.
- c) All controls, interlocks, indications, annunciation system etc. for each of the Fire Detection and Alarm Panels (located in Central Control room) and the Repeater Panel (located in Fire Station), shall have power supply from 24 V (2x12V) 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 OWS with Printer in the central control room shall be powered up by the respective UPS Power of the Plant Instrumentation and Control System.

- d) 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.
- e) The Battery driven Power supply shall be available to local zonal fire panels, 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.
- f) 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 45°C and 8°C respectively.

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

#### 24.4.8.1.2 Battery Charger

For design and construction of Battery Charger refer Volume : V

##### 24.4.8.1.2.1 Layout of Battery & Battery Charger

- a) The battery and charger of the respective panels shall be an integral part of each of the local fire protection panel / 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.

##### 24.4.8.1.2.2 Fittings & Accessories

Each battery shall be furnished with necessary accessories required.

#### 24.4.8.2 Contact Rating and Contact Multiplication for Pressure Switch/Limit Switch of Valves

- a) Contact rating of 10 Amps. at 240V A.C. or 0.5 Amp. at 220V DC is required to operate different circuits. If the same rating is not available from process switch contacts of the fire protection system, suitable auxiliary contactor/relay shall be included in the offer and provided in the respective panels to get the suitable number of contacts which can meet the current rating stipulated above.
- b) Further if the number of the process switch contacts of Fire Protection System are not adequate to meet the requirement for "System of Operation", annunciation and monitoring system, the same shall be included in the offer and provided in the respective Panels to get the

suitable number of contacts which can also meet the current stipulated above.

#### 24.4.8.3 Interlock Between "Fire Protection System" and Coal Handling Plant and Ventilation and Air Conditioning System

- a) In case of fire in any Zone of conveying system in coal Handling Plant, fire detector of that particular zone will operate at a preset value and an alarm will be annunciated in the Fire Alarm Panel located in Coal Handling Building. Simultaneously, the conveyor motor of the particular conveying system will be tripped automatically through IR Detector.
- b) In order to achieve this, "Detector Operated Digital Signal" will be generated in the Fire Panel by the Bidder (i.e. successful Bidder) with the help of auxiliary contactor/relay for interlock purpose to trip the conveyor motor. This signal shall be provided in the form of potential free (not changeover type) 1NO + 1NC contact combination for trip of each such conveyer motor.  
The list of such inputs required shall be developed by the successful Bidder.
- c) In case of fire in a zone/area where ventilation fans and/or Air-conditioning Ducts are installed similar "Detector Operated Digital Signal" shall be generated in the nearby Fire Panel. This digital signal shall also be generated in the form of potential free (not change-over type) 1NO + 1NC contact combination with the help of auxiliary contactor/relay for automatic trip or closing of each such ventilation fan-motor, fire damper of ventilation fan/duct, damper motor of Air-conditioning duct, blower motor of corresponding Air handling unit & compressor motor of chiller unit.
- d) The list of such inputs required shall be developed by the successful Bidder.
- e) The auxiliary contactor/relay required as mentioned in clause nos. a) and b) above shall have 24V D.C. power supply system provided in the respective Fire Protection Zonal Panels.
- f) Number of contacts for the auxiliary contactor/relay shall be 4NO + 4NC. The contact rating of each such auxiliary contactor/relay shall be of 10 Amps. at 240V A.C. or 0.5 Amp. at 220V D.C.
- g) Since the false ceiling of above area shall act as return duct of Air conditioning and since roof extractor is used without any ducting arrangement for ventilation system, detectors for air conditioning duct and ventilation duct are not envisaged. If Ducts will be decided during detail engineering, the same shall be required.

#### 24.4.8.4 Annunciation System

- a) A Board Sequence of Annunciation System shall be as per the following Table :

| Status | Visual Display | Audio Signal |
|--------|----------------|--------------|
| NORMAL | OFF            | OFF          |

|                                             |                  |     |
|---------------------------------------------|------------------|-----|
| FAULT                                       | ON WITH BLINKING | ON  |
| ACCEPT                                      | ON (STEADY)      | OFF |
| NORMAL BEFORE<br>ACCEPT                     | ON WITH BLINKING | ON  |
| FAULT CLEAR BUT NOT<br>RESET (after ACCEPT) | ON (STEADY)      | OFF |
| RESET WHEN FAULT IS<br>CLEARED              | OFF              | OFF |
| RESET WHEN FAULT IS<br>NOT CLEARED          | ON (STEADY)      | OFF |

- b) The detector zone connections shall be supervised to indicate fault condition in case of removal of one or more fire detectors from the detector base.
- c) All cabling between detector and the panel shall be supervised so as to indicate fault condition in case of open/short in detector cabling with a direct fault condition. The tone of this audio-alarm shall be distinct and different from that of zone wise fire alarm.
- d) The printed circuit cards provided for individual fire-zone shall be coated for prevention against corrosion. Gold plated connectors shall be provided for proper contacts.
- e) Separate set of "Accept", "Test" & "Reset" push buttons shall be provided for "Fault Alarm" and "Fire Alarm" systems.
- f) Each panel shall be provided with a hooter/buzzer, which shall have dual toners for differentiating the fire alarm with the fault alarm.
- g) Facility shall be provided for connection of external electrical hooter/gong, which shall be energised in case of fire alarm condition within any of the zones provided on the panel. The input for the hooter/gong shall be 24 Volt D.C.
- h) Fire Detection and Alarm Panels and Master Fire Alarm Panel shall also have "Fault Alarm" & "Fire Alarm" system. For this purpose potential free contacts shall be provided in the respective Satellite Fire panels for hook-up between Fire Detection and Alarm Panels/ Master Fire Alarm Panels and each Satellite Fire Panel.
- i) Each zone module shall have a facility for diagnostic check of all the related circuitry for their operation healthiness. The same shall be accomplished through the following push buttons :

**a) Fire,      b) Open,      c) Short,      d) Insulation level.**

#### **Fire proof sealing/Fire Stop/Fire Protection Coating System**

The fire-proof sealing/fire stop system/fire protection coating system is required to prevent spreading of fire from one place to another (or one zone

to another) through the openings in wall/floor, cables laid in trays / racks and openings below Electrical Switchgear / MCC / Distribution Boards / Cabinets / Panels etc.

### Fire-proof Sealing System

The material/components used for fire-proof sealing system shall be provided to meet the following requirements:

- a) Life expectancy should not be less than 30 years from the date of installation.
- b) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.
- c) Not to generate toxic gas and harmless to the personnel handling the system.
- d) Prohibition of production of acid or alkali during gas generation.
- e) Will not produce suffocating/corrosive gas.
- f) Repellant to pest/ rodent/ termite.
- g) Expansion co-efficient - very low, which is to be comparable with masonry concrete.
- h) Not soluble/reactive to acid, water, alkali.
- i) Thermal conductivity - low.
- j) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.
- k) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.
- l) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.
- m) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.
- n) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.
- o) The fire rating shall not be less than three (3) hours and the system shall be stable after application of water jet in the exposed side in order to extinguish fire.

### Fire Protection Coating to be Applied On Installed Cables

- a) The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

- i) At fire stops in walls and floors on either side upto 500 mm length.
  - ii) At fire stops below Electrical Switchgears / MCCs / Panels / Cabinets etc. on one side coating of 500 mm length i.e. on the cable vault side/cable trench side.
  - iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/cable trench.
  - iv) In fire risk areas and where specified at suitable intervals as decided upon site conditions in open cable routes.
  - v) Where necessary and specified at site at intervals along cable routes in cable trenches.
  - vi) The coating shall be applied evenly on the cables only.
- b) The fire protection coating shall have the following properties / composition:
- i) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.
  - ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.
  - iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEC-332-1 & IEEE- 383.
  - iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum sized cable at 180°C.
  - v) The limiting oxygen index of the material shall not be less than 35% as per ASTM D-2863.
  - vi) Life expectancy equivalent to the cable installations.

The various openings in the cable vault, vertical / horizontal raceways of cables penetrating walls / floors and the bottom of Electrical Switchgears / MCCs / Distribution Boards / Cabinets / Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/racks in the bunch formation. In case, for the purpose of installation of seal system, steel frames are required to be fabricated and fixed in the openings, the fabrication of frame and fixing of the same shall have to be done by the Bidder. The necessary steel section for fabrication of frames shall be supplied by the Bidder without any extra cost. Any, civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools and accessories required for addition or removal of cables after the seal is made. This shall include special tools, compound injection guns, spray guns, etc.

**Power and Control Cables**

Fire survival Power and Control Cables shall be of following types :

**a) Power Cables**

750V grade heavy duty mineral insulated copper sheathed copper conductor cable with outer covering of LSF material equivalent to BICC Fire Safe, conforming to BS:6207. The cables shall be rated for 950°C. for three hours and shall meet with requirements of CWZ class as per BS:6387. Minimum cross-section shall be 2.5 Sq.mm.

**b) Control Cables (for fire detection)**

Survival cables shall be similar to the above except that voltage grade shall be 500V in place of 750V. In addition the cables shall have high degree of immunity from electromagnetic interference. Minimum cross section shall be 1.5 Sq.mm.

**FRLS Power and Control Cables****a) Power Cables**

1.1 kV grade 85°C. rating heavy duty power cable with stranded Aluminium/Copper conductors, HRPVC insulation, extruded PVC inner sheath, round wire armour and extruded FRLS PVC overall sheath. Minimum cross-section shall be 2.5 Sq.mm. Cu. and 16 Sq.mm. Al.

**b) Control Cables**

1.1 kV grade, 70°C. rating control cables with stranded copper conductor, PVC insulation, extruded PVC inner sheath round wire armour, overall extruded FRLS PVC sheathed. Minimum cross-section shall be 1.5 Sq.mm. Cu.

**Instrumentation Cables**

- a) Bidder to refer Vol. V, Chapter 9 for details of instrumentation cables. For any binary or Analog signals, instrumentation cables shall be used as per design criteria & guidelines specified in Vol. V, Chapter 9.
- b) In Fire Protection & Detection system, Loop wiring & Panel networking shall be designed meeting the NFPA Style 7 requirements.

24.4.8

**CIVIL SUPPLY**

- a) Design and construction of Fire Water pump house including foundation of fire water system equipments (viz, pumps & motors, diesel engine, compressor etc.)
- b) Excavation, preparation of bed and backfilling with compaction for laying underground pipelines and underground cables (where approved by purchaser).
- c) Construction of RCC valve chamber as required.

- d) Construction of shed for deluge valve, Booster Pump House as per specification. The shed shall be of masonry enclosed structure with minimum four inch (4") RCC Roof.
- e) Construction of pylon support including foundation for spray water ring and water circuit for detection of H.T. Transformer, Oil tanks etc.
- f) Design & construction of foundation of clarified/ fire water reservoir mentioned above.
- g) Adequate no. of staircases as per National Building Code (NBC) and TAC.

#### 24.4.9 ELETRICAL, CONTROL & INSTRUMENTATION

Complete Electrical, Control & Instrumentation system for safe and reliable operation of the system shall be included as per design criteria & guidelines specified in Volume IV & Volume V.

- n) Fire stops/fire ceiling of two (2) hours rating at 750°C in wall/floors.
- o) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets etc. which are floor-mounted type.
- p) Fire retardant coating of thirty (30) minutes rating at 750°C to be applied for installed cables.
- n) Fire barrier / baffle wall in transformer yard, fire barriers for compartmentalizing the cable spreader rooms, fire proof door.
- q) Materials for fire barrier walls/baffle wall in Transformer Yard.
- r) Materials for fire barrier for compartmentalizing the cable spreader rooms.
- s) Materials for fire proof doors.

#### 24.4.10 Fire station & other facilities

Fire station is to be provided with facilities to park fire tenders, fire control room, fire officer room, store, dormitory for fire staff etc. Repeater Master Fire Alarm panel is provided in the fire station to monitor and control the fire in power station. This panel is provided with audio-visual alarms regarding status of fire in different areas, status of deluge valves, repeat annunciations from main fire detection and alarm panel in unit control room, PLC based panel fire water control cum alarm panel in fire water pump house & in foam pump house.

Fire station building shall have provisions of all the equipments required for smooth O&M of fire personals as per statutory regulations and norms. Service water, potable water, clarified/fire water line for filling fire tenders,

compressed air line shall be provided inside fire station along with handling, drainage, lighting, HVAC facilities. Following minimum equipments requirements:

a. MOBILE FIRE AND FOAM TENDER

Two (2) No. mobile Fire Tender, One (1) dry chemical tender and One (1) No. mobile Foam Tender shall be provided. The design requirements of mobile water tender shall conform to IS 950 and design requirements of mobile Foam tender shall conform to IS 10460. Supplementary extinguishing agent (dry chemical powder type), (Co2 type) and all accessories as per relevant IS code.

- b. Fire jeep: One no. fire jeep with trailer pumps with all accessories as per IS: 944 and its appendices
- c. Four (4) nos. of fire suits as per relevant IS code.
- d. Ten (10) nos. breathing apparatus (O2 cylinder) as per relevant IS code.
- e. Two (2) sets of first aid kits as per relevant IS code.
- f. Ten (10) sets of fibre glass blankets as per relevant IS code.
- g. Four (4) nos. of multipurpose nozzles.
- h. One (1) no. portable thermal imaging camera.

#### 24.4.11 Fire Extinguishers:-

Fire Extinguishers shall be installed in all the buildings within the Plant boundary as per TAC requirement. The Bidder shall supply the required quantities of Fire extinguishers and install the same at all location within the power plant boundary limits. Distribution of these extinguishers in various locations shall be as per TAC guidelines.

##### **Class-A**

Fire in ordinary combustibles such as wood, coal dust, vegetable, fibre, paper and the like.

##### **Class-B**

Fires in flammable liquids, paints, grease, solvents and the like.

##### **Class-E : Fires in Electrical and Control & Instrumentation Equipments**

To encounter the above classes of fires, extinguishers of Gas/Expelled water type, Carbon dioxide type, Dry chemical powder type and Mechanical Foam type shall be provided by the Bidder inside the Power House Building and all other main/auxiliary buildings where the above mentioned classes of fires are envisaged.

The selection of number of extinguishers for each type shall basically follow the guidelines laid down in Cl. No. 4.0 of the latest edition of the Fire Protection Manual Published by TAC.

**24.4.11.1 DESIGN, CONSTRUCTION AND SPECIFIC REQUIREMENTS**

- 24.4.11.1.1 Design and manufacture of the extinguishers shall conform to the latest editions of Indian and other equivalent International Standards and shall be suitable for respective design pressure, temperature and service conditions.
- 24.4.11.1.2 All the extinguishers along with accessories shall be guaranteed for satisfactory and trouble-free operation.
- 24.4.11.1.3 Portable extinguishers shall be complete with brackets/fittings suitable for mounting on wall and a carrying handle of ample strength.
- 24.4.11.1.4 Mobile extinguishers shall be provided with a wheeled trolley for movement. Trolley mounted extinguishers shall be provided with 6 or 9 meter long high pressure discharge hose with horn/ telescopic applicator.
- 24.4.11.1.5 Spanner and other accessories as required shall be supplied with each fire extinguisher.
- 24.4.11.1.6 Each extinguisher shall be designed, constructed, tested and painted in accordance with respective Indian/International Standard and marked with BIS Certification.
- 24.4.11.1.7 First charge of chemicals in each extinguisher shall be provided. All chemical charges shall be refilled after testing at site.
- 24.4.11.1.8 As required by Tariff Advisory Committee (TAC), 20% spare charge of the total no. of extinguishers installed, with a minimum of six recharges, shall be supplied for each type of extinguishers.
- 24.4.11.1.9 Fire extinguishers shall be fitted with pressure gauges as applicable to indicate whether the extinguisher is charged or in need of a recharge.
- 24.4.11.1.10 For design and construction standard, capacity and accessories of various portable/mobile extinguishers, datasheet appended shall be referred to.
- 24.4.11.1.11 The discharge horn of the Carbon-Dioxide Extinguishers shall be made of a material non-conducting to electricity.
- 24.4.11.1.12 All extinguishers shall be mounted at strategic locations in bunches and/or individually to TAC approval. These extinguisher cylinders shall have the approval of Chief Inspector of Explosive (CIE), Nagpur.

**24.4.12 Passive Fire Protection System:-**

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

**DATA SHEET FOR FIRE WATER PUMPS****DATASHEETS****A. FIRE WATER HYDRANT & SPRAY PUMPS**

| Sl. No. | Description                                                              | Electrical Motor Driven Pump           | Diesel Engine Driven Pumps |
|---------|--------------------------------------------------------------------------|----------------------------------------|----------------------------|
| 1.0     | <b>GENERAL INFORMATION</b>                                               |                                        |                            |
| 1.1     | Service Liquid                                                           | Water                                  | Water                      |
| 1.2     | Duty                                                                     | Intermittent                           | Intermittent               |
| 1.3     | Location                                                                 | In-door                                | In-door                    |
| 1.4     | Type                                                                     | Vertical Centrifugal Type              | Vertical Centrifugal Type  |
| 1.5     | Quantity of Hydrant Pumps                                                | 2                                      | 2                          |
| 1.6     | Quantity of Spray Pumps                                                  | 1                                      | 1                          |
| 1.7     | Rated capacity (m <sup>3</sup> /hr)/ Nos.                                | 410m <sup>3</sup> /hr                  | 410m <sup>3</sup> /hr      |
| 1.8     | Rated speed (RPM)                                                        | 1500 (max)                             | 1500 (max)                 |
| 1.9     | Total dynamic head MWC                                                   | 105/110/120 MWC                        | 105/110/120 MWC            |
| 2.0     | <b>MATERIAL OF CONSTRUCTION</b>                                          |                                        |                            |
| 2.1     | Base Plate                                                               | MS, IS:2062 Gr B                       |                            |
| 2.2     | Discharge elbow / Casing / Bowl / Suction Bell                           | CI, IS 210 Gr Fg 260                   |                            |
| 2.3     | Column Pipe                                                              | MS, IS:2062 Gr B                       |                            |
| 2.2     | Impeller                                                                 | SS 304                                 |                            |
| 2.3     | Shaft                                                                    | SS410                                  |                            |
| 2.4     | Shaft Coupling                                                           | SS 410                                 |                            |
| 2.5     | Line Bearing                                                             | Cutless nitrile rubber in SS shell     |                            |
| 2.6     | Shaft Sleeve                                                             | SS 410                                 |                            |
| 2.7     | Impeller Wearing rings                                                   | CF8                                    |                            |
| 2.8     | Stuffing Box                                                             | CI, IS210 Gr Fg 260                    |                            |
| 3.0     | Design standard                                                          | HIS/IS-6595 Part-2/Equivalent Standard |                            |
| 4.0     | Type                                                                     | -----Vertical Turbine-----             |                            |
| 5.0     | Impeller type                                                            | -----Closed-----                       |                            |
| 6.0     | Type of gland lubrication and sealing                                    | -----By Bidder-----                    |                            |
| 7.0     | Shaft sealing arrangement                                                | ----- Gland -----                      |                            |
| 8.0     | Axial thrust balancing device to be designed for pump shut-off operation | ----- Yes -----                        |                            |
| 9.0     | Type of pump-motor connection                                            | -----Direct -----                      |                            |
| 10.0    | Type of coupling                                                         | ----- Flexible Coupling -----          |                            |
| 11.0    | Mode of pump starting                                                    | -- Discharge valve fully open --       |                            |
| 12.0    | Supply of accessories & services                                         |                                        |                            |
|         | a) Base plate                                                            | ----- Yes -----                        |                            |
|         | b) Foundation bolts, nuts, sleeves etc.                                  | ----- Yes -----                        |                            |
|         | c) Suction & Discharge companion flanges with bolts, nuts & gaskets      |                                        |                            |
|         | 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 ----- |

**B. FIRE WATER BOOSTER PUMPS**

| Sl. No.    | Description                               | Electrical Motor Driven Pump | Diesel Engine Driven Pumps   |
|------------|-------------------------------------------|------------------------------|------------------------------|
| <b>1.0</b> | <b>GENERAL INFORMATION</b>                |                              |                              |
| 1.1        | Service                                   | Water                        | Water                        |
| 1.2        | Duty                                      | Intermittent                 | Intermittent                 |
| 1.3        | Location                                  | In-door                      | In-door                      |
| 1.4        | Type                                      | Horizontal Centrifugal Type  | Horizontal Centrifugal Type  |
| 1.5        | Quantity                                  | 1                            | 1                            |
| 1.6        | Rated capacity (m <sup>3</sup> /hr)/ Nos. | 137m <sup>3</sup> /hr        | 137m <sup>3</sup> /hr        |
| 1.7        | Rated speed (RPM)                         | 1500                         | 1500                         |
| 1.8        | Total dynamic head MWC                    | 50                           | 50                           |
| 1.9        | Sealing                                   | Mechanical Seal              | Mechanical Seal              |
| <b>2.0</b> | <b>MATERIAL OF CONSTRUCTION</b>           |                              |                              |
| 2.1        | Casing                                    | CAST STEEL                   |                              |
| 2.2        | Diffuser                                  | Fabricated CS as per IS 2062 | Fabricated CS as per IS 2062 |
| 2.3        | Impeller                                  | AISI-410                     | AISI-410                     |
|            | Wearing rings                             | AISI-410                     | AISI-410                     |
| 2.4        | Shaft                                     | AISI-410                     | AISI-410                     |
| 2.5        | Shaft sleeve                              | AISI-410 (Hardened)          | AISI-410(Hardened)           |
| 2.6        | Base plate                                | MS to IS: 2062               | MS to IS: 2062               |
| 2.7        | Shaft Sealing                             | Mechanical Seal              | Mechanical Seal              |
| 2.8        | Shaft Coupler                             | Forged/Cast Steel            | Forged/Cast Steel            |
| 2.9        | Wetted Fasteners                          | SS 316                       | SS 316                       |

**C. FIRE WATER JOCKEY PUMPS**

| Sl. No.    | Description                               | Electrical Motor Driven Pump |
|------------|-------------------------------------------|------------------------------|
| <b>1.0</b> | <b>GENERAL INFORMATION</b>                |                              |
| 1.1        | Service                                   | Water                        |
| 1.2        | Duty                                      | Intermittent                 |
| 1.3        | Location                                  | In-door                      |
| 1.4        | Type                                      | Vertical Centrifugal Type    |
| 1.5        | Quantity                                  | 2                            |
| 1.6        | Rated capacity (m <sup>3</sup> /hr)/ Nos. | 40 m <sup>3</sup> /hr        |



|            |                                 |                              |
|------------|---------------------------------|------------------------------|
| 1.7        | Rated speed (RPM)               | 1500                         |
| 1.8        | Total dynamic head<br>MWC       | 105/110/120 MWC              |
| 1.9        | Sealing                         | Mechanical Seal              |
| <b>2.0</b> | <b>MATERIAL OF CONSTRUCTION</b> |                              |
| 2.1        | Casing                          | 2.5% Ni CI: IS 210 Gr.FG.260 |
| 2.2        | Casing Liner                    | 2.5% Ni CI: IS 210 Gr.FG.260 |
| 2.3        | Diffuser                        | Fabricated CS as per IS 2062 |
| 2.2        | Impeller                        | AISI-410                     |
|            | Wearing rings                   | AISI-410                     |
| 2.3        | Shaft                           | AISI-410                     |
| 2.4        | Shaft sleeve                    | AISI-410 (Hardened)          |
| 2.5        | Base plate                      | MS to IS: 2062               |
| 2.6        | Shaft Sealing                   | Mechanical Seal              |
| 2.7        | Shaft Coupler                   | Forged/Cast Steel            |
| 2.8        | Wetted Fasteners                | SS 316                       |

**D. DIESEL ENGINE**

|  |                                                                     |                                                                                                                           |
|--|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
|  | GENERAL INFORMATION                                                 |                                                                                                                           |
|  | Service                                                             | Fire Water Pumps (Hydrant, Spray and Booster)                                                                             |
|  | Type                                                                | Compression ignition, mechanical (airless) Direct injection, multi cylinder and four stroke cycle and cold starting type. |
|  | Duty                                                                | Intermittent.                                                                                                             |
|  | ENGINE PARAMETERS                                                   |                                                                                                                           |
|  | Nominal output of engine at site operating under ambient conditions | Bidder to indicate during detailed engineering                                                                            |
|  | Speed of the engine                                                 | Not more than 2300 rpm                                                                                                    |
|  | Brake horse power rating at rated speed                             | As per TAC / Factory Mutual                                                                                               |
|  | Speed of the engine                                                 | As per TAC / Factory Mutual                                                                                               |
|  | Oil Lubrication System                                              | As per TAC / Factory Mutual                                                                                               |
|  | Fuel Oil System                                                     | As per TAC / Factory Mutual                                                                                               |
|  | Governing system                                                    | As per TAC / Factory Mutual                                                                                               |
|  | Starting System                                                     | As per TAC / Factory Mutual                                                                                               |
|  | Cooling System                                                      | As per TAC / Factory Mutual                                                                                               |
|  | Manufacturer                                                        | As Per approved Vendor List                                                                                               |
|  | IS Standard Applicable                                              | IS:3046                                                                                                                   |
|  | No. of cylinders                                                    | 4 Inline                                                                                                                  |
|  | No of stroke                                                        | 4 stroke                                                                                                                  |
|  | Cooling                                                             | Heat Exchanger                                                                                                            |
|  | Battery Type and Volts                                              | Ni- Cd(12 V)-2x100%                                                                                                       |
|  | Battery Charger                                                     | 2x100%                                                                                                                    |
|  | Fuel Tank Capacity                                                  | Min 4 Hrs(As Per TAC)                                                                                                     |
|  | Spare Parts                                                         | As per TAC Clause 7.4.5.11                                                                                                |

**E. PIPING AND FITTINGS AND SPECIALTIES**

| 1.00.00 | Type             | Buried pipes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Over ground pipes normally full of water | Over ground Pipes normally empty but periodically charge with water & foam system applications | Over ground 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 | AS per IS Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          |                                                                                                |                                  |
| 4.00.00 | Pipe Protection  | Refer Volume II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |                                                                                                |                                  |
| 5.00.00 | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                          |                                                                                                |                                  |
| 6.00.00 | Construction     | ----- ERW -----                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |                                                                                                |                                  |
| 7.00.00 | Joints           | <p>Butt-welded for size 65 mm NB &amp; higher as per ANSI B 16.9 and socket welded for sizes up to 50 mm NB as per ANSI B16.11</p> <p>Screwed flange as required for dismantling purposes for sizes 65 mm NB &amp; above as per ANSI B 16.5 and screwed socket for sizes 50 mm NB &amp; below.</p> <p>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 Owner. After welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further the Bidder shall provide proper zinc paint at the point of welding.</p> |                                          |                                                                                                |                                  |

|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                    |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.00.00 | Fittings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 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. |
|         | Ratings/Wall thickness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                    |
|         | Material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | The material shall conform to ASTM A234 Gr. WPB or ASTM A 105 or equivalent.                                                                                                                                                                                       |
| Notes : | 1. All fittings and flanges for galvanized pipes shall be galvanized.<br>2. Unless otherwise specified, all elbows/bends shall be long radius type.<br>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 reduction instead of standard tees.<br>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. |                                                                                                                                                                                                                                                                    |

**E. VALVES AND SPECIALTIES**

| Cl. No.    | Description                   | Specification Requirement                                                                           |
|------------|-------------------------------|-----------------------------------------------------------------------------------------------------|
| <b>1.0</b> | <b>C.I. Gate Valves</b>       |                                                                                                     |
| 1.1        | Type                          | Rising spindle type<br>(For Above ground Piping and Non Rising Spindle type for Underground piping) |
| 1.2        | Code / Standard               | IS-14846 for sizes 65 mm NB to 300 mm NB.<br>IS-2906 for sizes 350mm NB and above.                  |
| 1.3        | Material of construction      |                                                                                                     |
|            | Body                          | CI IS: 210 Gr FG 260                                                                                |
|            | Bonnet                        | CI IS: 210 Gr FG 260                                                                                |
|            | Stem                          | Gun metal IS: 315 CTB2 or IS: 320 HT2                                                               |
|            | Wedge disc                    | CI IS: 210 Gr. FG 260                                                                               |
|            | Body seating ring             | Renewable, gun metal to IS: 315 LTB2 or IS: 318 LTB2                                                |
|            | Back sheet                    | Renewable, gun metal to IS: 315 LTB2                                                                |
|            | Stem packing                  | Renewable, expanded PTFE                                                                            |
|            | Hand wheel                    | CI IS: 210 Gr. 260                                                                                  |
|            | Bonnet bolts & nuts           | CS IS: 1367                                                                                         |
|            | Bonnet gasket                 | Neoprene or Teflon                                                                                  |
| 1.4        | Testing                       | As per IS: 14846                                                                                    |
| 1.5        | Approval                      | ISI marked / TAC approved                                                                           |
| <b>2.0</b> | <b>Gun Metal Globe Valves</b> |                                                                                                     |
| 2.1        | Type                          | Rising spindle                                                                                      |
| 2.2        | Code / Standard               | IS: 778 / BS 13789                                                                                  |
| 2.3        | Material of construction      |                                                                                                     |
|            | Body                          | GM, IS: 318 Gr. 2, Casting                                                                          |
|            | Bonnet                        | GM, IS: 318 Gr. 2                                                                                   |
|            | Disc                          | GM, IS: 318 Gr. 2, Guided                                                                           |
|            | Stem                          | HT brass, IS: 320, OS & Y, Forged                                                                   |
|            | Seat ring                     | GM, IS: 318, Gr. 2, Renewable                                                                       |
|            | Gasket (Bonnet)               | CAF, IS: 2712                                                                                       |

**CHAPTER 7: PAINTING****1.0 SCOPE**

This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted. The painting system should ensure optimal protection of the installation with minimum need for maintenance, environmental friendly & easy to apply.

**2.0 CODES AND STANDARDS**

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS contract for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

|                         |   |                                                                                                                                                                                                                     |
|-------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IS: 5                   | : | Colours for ready mixed paints and enamels                                                                                                                                                                          |
| IS: 101                 | : | All Parts and Sections for paint testing                                                                                                                                                                            |
| IS: 1303                | : | Glossary of terms relating to paints                                                                                                                                                                                |
| IS: 2379                | : | Colour code for identification of pipelines                                                                                                                                                                         |
| IS: 1477                | : | Code of practice for painting of ferrous metals in buildings (Parts I & II)                                                                                                                                         |
| IS: 2524                | : | Code of practice for painting of non-ferrous metals in buildings (Parts I & II)                                                                                                                                     |
| IS: 6278                | : | Code of practice for white washing and colour Washing                                                                                                                                                               |
| IS: 13183               | : | Aluminium Paint, heat Resistant specification                                                                                                                                                                       |
| IS: 158                 | : | Ready mixed paint, brushing, bituminous, black, Lead free, acid, alkali, water and heat resisting                                                                                                                   |
| IS: 2074                | : | Ready mixed paint, air drying, red Oxide Zinc Chrome, priming                                                                                                                                                       |
| IS: 104                 | : | Ready mixed paint, brushing, Zinc Chrome, priming                                                                                                                                                                   |
| IS: 2932                | : | Enamel, synthetic, exterior (a) undercoating (b) finishing.                                                                                                                                                         |
| IS: 2629                | : | Recommended Practice for Hot Dip Galvanising                                                                                                                                                                        |
| BS EN ISO 14713         | : | Code of practice for protection of iron & steel structure against corrosion                                                                                                                                         |
| ISO 8501-1              | : | Preparation of steel substrates before application of paint & related Products. Part-1: Rust grades & preparation grades of uncoated steel substrates & steel substrates after overall removal of previous coatings |
| ISO 8502-3              | : | Assessment of dust on steel surface prepared for painting (Pressure sensitive tape method)                                                                                                                          |
| ISO 12944 (Part 1 to 7) | : | Corrosion protection of steel structures by Protective paint systems                                                                                                                                                |
| SSPC                    | : | US Specifications of Steel Structures Painting Council, SSPC Volumes I and II                                                                                                                                       |
| SSPC-SP-08              | : | Surface preparation by Pickling                                                                                                                                                                                     |
| NORSOK M-501            | : | Surface preparation & Protective coating                                                                                                                                                                            |
| ISO 20340               | : | Pre-Qualification test                                                                                                                                                                                              |
| ASTM                    | : | American Standard Test Method for paints and coatings                                                                                                                                                               |
| AWWA                    | : | American Water Works Association                                                                                                                                                                                    |

SIS: 55900 : Swedish standard for blasting

In the event of conflict between the Codes and Standards referred to in the specification and the requirement of this specification, the latter shall govern. Statutory and Local regulations shall be strictly followed in selection and application of paint.

### 3.0 GENERAL

- 3.1 This specification covers the surface preparation, method of application and material to be used for all coating of equipment, steel structures and piping. Steel material subjected to surface preparation on shop/site shall have minimum requirements in accordance with Rust Grade B (SSPC/SSPM Volume-2).
- 3.2 Coating materials according to SSPC, EN ISO, ASTM, BIS or DIN standards, shall be used. The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.
- 3.3 The paint to be applied shall be approved by Customer / Engineer.
- 3.4 All paints & paint material used shall be procured from approved manufacturers. Paint shall be supplied in manufacturers original containers with the description of content, specification No., colour, ref no, date of manufacture, shelf life expiry date & pot life.
- 3.5 The paint manufacturers shall provide coating system data sheet for each coating system to be used containing the following information:
1. Surface preparations
  2. Film thickness (min and max)
  3. Min and max recoating intervals at relevant temperatures
  4. Mixing ratio, thinner details and coating repair systems
- 3.6 The sample for testing the paint being used may be taken by the customer at any time.
- 3.7 In general Shop fabricated equipment will be delivered to the site coated with a shop applied system or the manufacturer's standard finish in accordance with the requirements of this specification.
- 3.8 For equipment that has received shop prime coat, touch-up prime coat and additional coats shall be applied in accordance with the coating schedule. It is responsibility of the vendor to ensure compatibility between shop and field applied paint systems.
- 3.9 Necessary precautions shall be provided to all equipment, structures to protect other surfaces from abrasive blasting, coating over spray and spatter. Damage to other surfaces or equipment shall be repaired by the vendor.
- 3.10 The Contractor shall submit the following for review and approval by the Customer:



1. Manufacturer's recommended paint scheme for the project
2. Latest published product & instructions for application data,
3. Procedures for surface preparation and application.
4. Pre qualification for equipments and blasting materials, product, procedure and personnel qualifications for the paint and painting systems.
5. Painting repair procedures

Painting records shall contain:

- Equipment/components/location painted
- Date of painting
- Paint details such as specification No, colour, date of manufacture, shelf life, expiry date
- Application equipments
- Ambient conditions at the time of painting
- Surface temperature
- Drying time between coating, DFT and number of coatings
- Appropriate work plan for painting.

- 3.11 The supply of all necessary equipments, weather protection, and scaffolding for painting to ensure work is carried out in accordance with the specification and agreed programme.
- 3.12 Maintenance of the paint work until completion of the contract, this shall include repair of any damaged areas caused by third party.
- 3.13 Disposal of painting waste resulting from painting, shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work and coating materials.
- 3.14 It is a mandatory requirement that all operatives working to this procedure take full cognizance and implement necessary safety precautions.

#### 4.0 PREPARATION OF SURFACES

- 4.1 All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust, weld spatters, sharp edges and any other foreign matter. Removal of grease and oil contamination shall be in accordance with SSPC-SP1 prior to cleaning process described below.
- 4.2 Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, hand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the Engineer.
- 4.3 The blast cleaned surface shall be checked for signs of salt contamination as per ISO 8502-6 & 9. The maximum allowable level of contamination shall be 20 mg/m<sup>2</sup>. Surfaces that do not meet these criteria shall be reprocessed.

#### Mechanical Cleaning:

Manual/power tool cleaning shall be done as per grade St-2 or St-3, of ISO 8504-3. This method to be used for repair painting or on already painted



surface and in case of usage on new construction painting prior approval may be obtained from purchaser/engineer.

|                     | Condition of surface | ISO 8504-3 | SIS 055900 | SSPC |
|---------------------|----------------------|------------|------------|------|
| Hand tool cleaning  | Rusted               | C St2      | C St2      | SP2  |
|                     | Rusted and pitted    | D St2      | D St2      | SP2  |
| Power tool cleaning | Rusted               | C St3      | C St3      | SP3  |
|                     | Rusted and pitted    | D St3      | D St3      | SP3  |

- i) Grade St-2: Thorough scraping and wire brushing, machine brushing, grinding etc. This grade of preparation shall remove loose mill scale, rust and foreign matter. Finally the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation, the surface should have a faint metallic sheen. The appearance shall correspond to the prints designated St-2.
- ii) Grade St-3: very thorough scraping and wire brushing, machine brushing, grinding etc. After preparing the surface, it should have a pronounced metallic sheen and correspond to the prints designated St-3.

#### Blast cleaning:

**Compressors:** Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air at 110deg C. The blasting activity shall be performed at ambient temperatures above 5°C and relative humidity less than 85%. Steel temperature shall be 3°C above dew point. Necessary safety precautions for equipment and operator shall be adhered to.

**Abrasives:** Abrasives used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives may be chilled iron grit or shot steel and malleable iron grit and shots non metallic abrasive (aluminium oxide, copper slag, garnet etc.).

Removal of mill scale and rust using abrasives such as grit or shot under high pressure. The grade of blasting performed in line with the approved painting scheme.

Surfaces to be coated shall be free of all grease, oil, loose rust, and loose mill scale. Rust, mill scale, weld spatter, flux, shall be removed by the methods indicated in the Coating Schedule. Oil and grease shall be removed by solvent cleaning method as outlined in SSPC - SP – 1 prior to blasting.

The quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the surface profile depth and cleanliness. Abrasives shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertaining to the work.

Profile measurements for abrasive blast cleaned surface shall be made with a Profile comparator and permanent record shall be maintained with Testex Press-O-Film.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and

commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

After blasting cleaning, depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 mm may be used.

The grades of surface finish:

|                  | ISO 8501-1 | SIS 055900 | SSPC | NACE |
|------------------|------------|------------|------|------|
| White metal      | Sa3        | Sa3        | SP5  | 1    |
| Near White metal | Sa 2½      | Sa 2½      | SP10 | 2    |
| Commercial blast | Sa2        | Sa2        | SP6  | 3    |
| Brush off blast  | Sa1        | Sa1        | SP7  | 4    |

## Paint Application

### General:

Paints and other coating materials shall be applied in accordance with the paint manufacturer's instructions. The surface preparation and painting system shall be as described in ANNEXURE with the following exceptions:

- Nameplates, code stampings and push buttons
- Concrete brickwork, tile, and glass unless specified by the Purchaser / Engineer
- Non-ferrous materials
- Austenitic stainless steel
- Plastic and / or plastic coated materials
- Insulated surface of equipment and pipes except colour coating wherever required
- Any surface specified by the Purchaser / Engineer not to be painted.

### Paint Application Requirements

The paint shall be applied in accordance with the paint manufacturer's product data sheet, which shall include the mix ratio, the method of application, and the use of thinners and over coating times.

Paint application shall be by brush, roller or spray gun. Local regulations regarding spray and roller coating shall be observed. A smooth uniform film shall be applied to the surfaces to be coated.

Painting shall be performed when the temperature of the surface is greater than 3°C above the dew point of the surrounding air and relative humidity of the air is less than 85% unless local conditions dictate otherwise and the Customer is in agreement. Guidance on the estimation of the probability of condensation can be found in ISO 8502-4. The measurement of these conditions is the responsibility of the Vendor.

In addition, paints shall not be applied under the following conditions:

- When the surface temperature is greater than 60 °C (unless a higher temperature is agreed by the paint manufacturer)
- When the air temperature is less than approximately 5°C, (depending on local conditions)

- When there is the likelihood of an unfavourable change in weather conditions within two hours after painting
- When there is a deposition of moisture in the form of rain, condensation, frost, etc., on the surface.
- When the available light is less than 500 lux.

Paints shall not be applied within 50 mm of edges which will later have to be welded. Such weld areas shall be taped/one coat of weldable primer for distance of 50 mm either side of the weld line.

When zinc rich primers are used, care shall be taken to mask to avoid any possibility of over spraying onto duplex, austenitic stainless steels; nickel alloys or 9% nickel steel components.

Two pack coatings like Air drying epoxy, Polyurethane coatings etc shall be mixed in the ratio recommended by manufacturer to ensure proper and complete curing of the coatings. The base and hardener are to be separately mixed first to obtain a homogenous mixture. The hardener is to be added to the base slowly, with continuous mixing / agitation and not the reverse. Power agitation is preferred over hand mixing.

Any addition of thinner to achieve the application viscosity should be made only after the components are thoroughly mixed. Excess thinner is not recommended, as increase in volume, leads to lower DFT, sagging, longer curing time, etc.

Coating containing heavy or metallic pigments that have a tendency to settle shall be kept in suspension by continuous use of a mechanical agitator whilst being applied, to ensure uniformity over the surface area (e.g., zinc MIO's pigmented materials).

Transport and erection of painted structures shall be carried out only after the drying time specified by the paint manufacturer has elapsed. Handling & packing of painted material shall be appropriate to avoid damage to painting, such as the use of non-metallic slings, etc for handling and by minimising handling after painting. All steel equipment shall be provided with priming or coating system to protect the steel surface during transport, storage, installation and construction.

### **Spray Application**

Airless or pneumatic spray applications are preferred methods of application. Spraying shall be carried out keeping the spray gun at the minimum suitable distance from the work piece and consistently at 90° to the surface being painted.

Approval of Purchaser / Engineer shall be obtained during spray painting which may cause interference to other works. If spray painting is to be carried out, the following shall be taken into account:

The correct spray tips, air pressures, etc, as recommended by the equipment supplier, shall be used.

Conventional air spray equipment is used, the correct combination of air volume, air pressure and fluid flow to give good atomisation to be ensured to



get a defect free painted surface. The major disadvantage of conventional air spray is that high build coatings can generally not be applied by this method as most paints have to be thinned to a suitable viscosity for satisfactory atomisation, and so lose their high build properties. Vendor shall follow manufacture's instruction.

Air spray (pressure pot) is recommended in cases where large quantities of paint are to be applied as paint in the tank can be prevented from settling, reduces application time and also enables the gun to be turned to any angle to coat objects effectively without spilling paint.

Airless spray is recommended as high build coatings can be applied without thinning, very rapid application is possible, giving an economic advantage, compared to conventional spray, overspray and bounce-back are reduced, leading to reduced losses of material and less dust and fume hazards.

Each coat shall be applied uniformly and completely over the entire surface. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface re-sprayed.

Very complex structures should be painted by brush instead of spray gun to avoid overspray, dry spray and unacceptable paint losses.

### **Brush application**

Brush application may be used under the following circumstances:

- When areas cannot be properly coated by spraying for reasons such as material or environmental considerations
- For the initial coat of paint to corners, edges, crevices, holes, welds or irregular surface prior to spray application
- For "touch up" or repairs to localized damaged paint or areas of incorrectly applied paint
- Where the paint manufacturer considers the coating material suitable for brush application.

Brushes shall be of a style and quality that will permit the proper application of paint.

Brush applications should be done in two passes that are perpendicular to each other 'wet on wet' so that a smooth coat, as near uniform in thickness as possible, is obtained thereby avoiding running and droplets. There should be no deep or detrimental brush marks. Paint shall be worked into all crevices and corners. Runs and sags shall be brushed out.

During the application of each coat, all areas such as corners, edges, welds, small brackets, bolts, nuts and interstices shall receive additional paint to ensure that these areas have at least the minimum specified dry film thickness and to ensure continuity of coating.

### **Roller application**

Roller application shall only be used on relatively large surface areas and only if spraying is not an option. Roller application shall only be used if the first or priming coat of paint has been applied by brush. Roller application shall be in accordance with the paint Manufacturer's instructions.

**Coating materials**

The selected coating materials shall be suitable for the intended use and shall be selected after an evaluation of all relevant aspects such as

- Corrosion protective properties
- Requirements to health, safety and environment
- Properties related to application conditions, equipment and personnel
- Experience with the coating materials and coating system.

All coating materials and solvents shall be protected from ignition sources and shall remain within storage temperatures and storage conditions recommended by the coating manufacturer. All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions. Performance standard as listed below shall be established by paint manufacturer the records shall be submitted for review.

- Adhesion test (pull off test)
- Flexibility test
- Salt spray test (min 1000 Hrs)
- Water absorption test
- UV resistance test (external coating)
- Cathodic disbonding test (internal coating)
- Abrasion test (internal coating)
- Impact resistance test
- Sea water immersion test (structures in tidal, splash zone and conveying sea water)

Each product shall have a batch number showing year and month of manufacture and giving full traceability of production. Shelf life shall be included in the technical data sheet. All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions.

The composition of the paint shall be at the discretion of the manufacturer, provided that the finished product meets the requirements of, State or Local regulatory bodies for the products. All vehicle components for use in the manufacture of paints and enamels shall meet the ASTM/ ISO Specification except as otherwise stated coating systems shall be selected as per corrosivity category listed in the table below. Coating systems are tabulated in ANNEXURE and shall be pre-qualified in accordance with specification. Coating systems/ alternative coating systems may be re-subjected to pre-qualification, at the discretion of OWNER/ ENGINEER. The specified coating systems, the number of coats and the coating film thicknesses given in Annexure are minimum requirements Top coat colors should be in accordance with Annexure.

**Gratings and step threads**

- i) Surface preparation

Gratings and step threads shall be cleaned by acid pickling as per SSPC-SP-08.

- ii) Hot dip galvanising

The hot dip galvanising shall be done as per IS 2629 .The average mass of coating shall be 610 gms/m<sup>2</sup>.



## iii) Post galvanising treatment

Immediately after galvanising, post treatment such as chromating shall be applied to retard white rust attack.

## iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A 780.

**CORROSIVITY OF ENVIRONMENTS**

| Corrosivity category |                               | Mass loss per unit surface<br>(per year of exposure) |                        |
|----------------------|-------------------------------|------------------------------------------------------|------------------------|
|                      |                               | Mass loss g/mm <sup>2</sup>                          | Thickness loss $\mu$ m |
| C2                   | Low                           | >10 to 100                                           | >1.30 to 25            |
| C3                   | Medium                        | 200-400 g/m <sup>2</sup>                             | (25-50 $\mu$ m)        |
| C4                   | High                          | 400-650 g/m <sup>2</sup>                             | (50-80 $\mu$ m)        |
| C5                   | Very High Industrial & marine | 650-1500g/m <sup>2</sup>                             | (80-200 $\mu$ m)       |

Tests required for evaluation of acceptance of coating materials:

**TABLE -1****PERFORMANCE TEST OF PAINT**

| SL. No. | Test                                | ASTM TEST METHOD       |
|---------|-------------------------------------|------------------------|
| 1.0     | Abrasion Resistance: (topcoat only) | ASTM D4060             |
| 2.0     | Adhesion:                           | ASTM D4541             |
| 3.0     | Dry Heat Resistance:                | ASTM D2485             |
| 4.0     | Flexibility: (topcoat only)         | ASTM D522, 180° bend   |
| 5.0     | Pencil Hardness: (topcoat only)     | ASTM D3363             |
| 6.0     | Salt Fog Resistance:                | ASTM B117, 1000 hours  |
| 7.0     | Weather Resistance:                 | ASTMG23 Type D         |
| 8.0     | Test                                | ASTM Test Method       |
| 9.0     | Density                             | D 1475                 |
| 10.0    | Dipping properties                  | D 823                  |
| 11.0    | Drying time                         | D 1640                 |
| 12.0    | Flexibility                         | D 1737/D 522           |
| 13.0    | Hardness                            | D 3363                 |
| 14.0    | Adhesion (pull off test)            | D 4541                 |
| 15.0    | Abrasion resistance                 | D 968/D 4060           |
| 16.0    | DFT/Coat                            | As per SSPC Guidelines |
| 17.0    | Storage Stability                   | D 1849                 |
| 18.0    | Resistance to                       |                        |
|         | i) Humidity for 2000 hrs.           | D 2247                 |
|         | ii) Salt Spray for 2000 hrs.        | B 117                  |
|         | iii) Accelerated Weathering         | D 822                  |

**INSPECTION:**

Inspection will be performed by an inspector authorised by Purchaser / Engineer. Paint materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specification and shall be accompanied by manufacturer's test certificates.

The painting work shall be subjected to inspection by purchaser / engineer at all times. The vendor shall offer following stage of inspection:

- Surface preparation
- Primer application
- Subsequent coats
- Paint qualification test

Vendor shall provide the expert technical services of the paint manufactures as and when required by purchaser / engineer to ensure both the surface preparation and applications are carried out as per their recommendations. This service shall be provided without any obligation to purchaser.

The following coating inspection & test shall be carried out:

1. Ambient and steel temperature, relative humidity and dew point min twice in a shift.
2. Surface finish & profile check each component or once per 10 m<sup>2</sup> after surface preparation.
3. Salt contamination test - Free from salt contamination.
4. Dry Film Thickness as per ISO 2808 No.6.
5. Holiday Test as per ASTM D 5162/ NACE RP 0188.
6. Adhesion Test as per ISO 2409 for cross-cut test, or a pull-off test as per ISO 4624/ ASTM D 4541.

**6.0 SUGGESTED COLOUR CODES FOR PAINTING:**

| Sl. No. | Item / Service                                                            | Colour              | IS-5                   | Colour (Band) | IS-5 |
|---------|---------------------------------------------------------------------------|---------------------|------------------------|---------------|------|
| 1.0     | Structures, platforms, ladders and handrails                              | Dark Admiralty Grey | 632                    |               |      |
| 2.0     | Boiler casing, ESP and ducting                                            | Nut Brown           | 413                    |               |      |
| 3.0     | Fans, pumps, motors,                                                      | Light Grey          | 631                    |               |      |
| 4.0     | Tanks (without insulation and cladding)                                   |                     |                        |               |      |
| 4.1     | Outdoor                                                                   | Aluminium           |                        |               |      |
| 4.2     | Indoor                                                                    | Light grey          | 631                    |               |      |
| 5.0     | Vessels & all other proprietary equipment (without insulation & cladding) | Light grey          | 631                    |               |      |
| 6.0     | Switchgear                                                                | Light grey          | 631                    |               |      |
| 7.0     | Control & relay panels                                                    | Light grey          | 631<br>78 of<br>IS1650 |               |      |
| 8.0     | Turbine                                                                   | Golden              | 356                    |               |      |



| Sl. No. | Item / Service                           | Colour        | IS-5 | Colour (Band) | IS-5 |
|---------|------------------------------------------|---------------|------|---------------|------|
|         |                                          | Yellow        |      |               |      |
| 9.0     | Generator & exciter                      | Light grey    | 631  |               |      |
| 10.0    | Transformers                             | Aluminium     |      |               |      |
| 11.0    | Machinery guards                         | Signal red    | 537  |               |      |
| 12.0    | Crane                                    |               |      |               |      |
| 12.1    | Crane structure                          | Golden Yellow | 356  |               |      |
| 12.2    | Trolley and hook                         | Crimson       | 540  |               |      |
| 13.0    | Piping (without insulation and cladding) |               |      |               |      |
| 13.1    | Water System                             |               |      |               |      |
| 13.1.1  | Boiler feed                              | Sea green     | 217  |               |      |
| 13.1.2  | Condensate                               | Sea green     | 217  | Light brown   | 410  |
| 13.1.3  | Bearing cooling water                    | Sea green     | 217  | French blue   | 166  |

**Notes:**

1. This colour code basically refers to IS: 2379 for piping with necessary modifications.
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

## PAINTING SCHEME FOR C2 AND C3 ENVIRONMENT

| S. No | Description                                                                   | Surface Preparation | Primer                                                                                                    |              |      | Intermediate paint |              |       | Finish coat                 |              |      | Total DFT |
|-------|-------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------|--------------|------|--------------------|--------------|-------|-----------------------------|--------------|------|-----------|
|       |                                                                               |                     | Paint                                                                                                     | No. of coats | DFT  | Paint              | No. of coats | DFT   | Paint                       | No. of coats | DFT  | Min.      |
| 1.    | Boiler structure, un-insulated ducts, suspensions, hangers temperature <120°C | Sa 2 ½              | In organic Zn silicate                                                                                    | 2            | 80 μ | HB MIO epoxy       | 1            | 120 μ | Poly urethane               | 2            |      | 260μ      |
| 2.    | Indoor structure                                                              | Sa 2 ½              | HB Zn Phosphate                                                                                           | 2            | 80 μ | HB MIO epoxy       | 1            | 120 μ | --                          | --           | --   | 260μ      |
| 3.    | Insulated parts exposed to temp >120°C                                        | Sa 2 ½              | In organic Zn silicate                                                                                    | 2            | 60 μ |                    |              |       |                             |              |      | 60μ       |
| 4.    | Work shop                                                                     | Sa 2 ½              | HB Zn Phosphate                                                                                           | 2            | 80 μ | HB MIO epoxy       | 1            | 120 μ | --                          | --           | --   | 260μ      |
| 5.    | Water Treatment Plant (external)                                              | Sa 2 ½              | Zn rich epoxy                                                                                             | 2            | 80 μ | HB MIO epoxy       | 2            | 200 μ | Aliphatic poly urethane     | 2            | 80 μ | 360μ      |
| 6.    | Coal Handling Plant                                                           | Sa 2 ½              | In organic Zn silicate                                                                                    | 2            | 80 μ | HB MIO epoxy       | 1            | 120 μ | poly urethane               | 2            | 60 μ | 260μ      |
| 7.    | Fuel pipings                                                                  | Sa 2                | Ehthy Zn silicate                                                                                         | 1            | 40 μ |                    |              |       | HR aluminium paint          | 2            | 40 μ | 80μ       |
| 8.    | Un insulated silencer, steel stacks >120°C                                    | Sa 2 ½              | Ehthy Zn Silicate                                                                                         | 1            | 40 μ |                    |              |       | HR silicone aluminium paint | 2            | 40 μ | 80μ       |
| 9.    | Above ground piping                                                           | Sa 2 ½              | In organic Zn silicate                                                                                    | 2            | 80 μ | HB MIO epoxy       | 1            | 120 μ | Poly urethane               | 2            | 60 μ | 260μ      |
| 10.   | Burried piping (External)                                                     | Sa 2 ½              | Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel impregnated fibre |              |      |                    |              |       |                             |              |      | 4.0m m    |
| 11.   | Burried piping (Internal)                                                     | Sa 2 ½              | Solid rigid poly urethane 500 μ                                                                           |              |      |                    |              |       |                             |              |      | 500μ      |
| 12.   | Storage tanks (external)                                                      | Sa 2 ½              | In organic Zn silicate                                                                                    | 2            | 80 μ | HB MIO epoxy       | 1            | 120 μ | Poly urethane               | 2            | 60 μ | 260μ      |
| 13.   | Storage tanks (internal)                                                      | Sa 2 ½              | 3 coats of amine adducts                                                                                  |              |      |                    |              |       |                             |              |      | 400μ      |



1 x 660 MW - Panki Thermal Power Station

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



|     |                                                                     |        |                                       |   |       |              |   |       |                    |   |       |       |
|-----|---------------------------------------------------------------------|--------|---------------------------------------|---|-------|--------------|---|-------|--------------------|---|-------|-------|
| 14. | DM water piping (internal)                                          | Sa 2 ½ | Hard rubber lining min 4 mm thickness |   |       |              |   |       |                    |   |       | 4. mm |
| 15. | DM water tank (internal)                                            | Sa 2 ½ | In organic Zn silicate                | 2 | 80 μ  | HB MIO epoxy | 1 | 150 μ | HB coal tar epoxy  | 1 | 150 μ | 380μ  |
| 16. | Fuel oil tanks (internal)                                           | Sa 2 ½ | In organic Zn silicate                | 2 | 80 μ  | HB MIO epoxy | 1 | 150 μ | HB coal tar epoxy  | 1 | 150 μ | 380μ  |
| 17. | Insulated parts continuously exposed to condensing water            | Sa 2 ½ | In organic Zn silicate                | 2 | 75 μ  |              |   |       |                    |   |       | 75μ   |
| 18. | For insulated piping <125°C                                         | Sa 2 ½ | Polyamide cured epoxy coating         | 2 | 250 μ |              |   |       |                    |   |       | 250μ  |
| 19. | Electrical parts, control panels, valves, pumps & motors (indoor)*  | Sa 2 ½ | Zn phosphate epoxy                    | 2 | 80 μ  |              |   |       | Chlorinated rubber | 2 | 80 μ  | 160μ  |
| 20. | Electrical parts, control panels, valves, pumps & motors (outdoor)* | Sa 2 ½ | Zn phosphate epoxy                    | 2 | 80 μ  |              |   |       | Chlorinated rubber | 2 | 100 μ | 180μ  |
| 21. | Switch yard, floor grills walk ways                                 | Sa 2 ½ | Hot dip galvanising 80μ               |   |       |              |   |       |                    |   |       | 80μ   |

\* Note: Manufacturer to specify details of painting system capable of withstanding environmental conditions for a period of 10 years before first maintenance



## PAINTING SCHEME FOR C4 AMD C5 ENVIRONMENT

| S. No | Description                                                                   | Surface Preparation | Primer                                                                                  |              |      | Intermediate paint |              |       | Finish coat                 |              |      | Total DFT |
|-------|-------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------|--------------|------|--------------------|--------------|-------|-----------------------------|--------------|------|-----------|
|       |                                                                               |                     | Paint                                                                                   | No. of coats | DFT  | Paint              | No. of coats | DFT   | Paint                       | No. of coats | DFT  | Min.      |
| 1.    | Boiler structure, un-insulated ducts, suspensions, hangers temperature <120°C | Sa 2 ½              | HB Zn Phospate                                                                          | 2            | 80 µ | HB MIO epoxy       | 2            | 200 µ | Epoxy PU HB                 | 2            | 80 µ | 360µ      |
| 2.    | Indoor structure                                                              | Sa 2 ½              | HB Zn Phospate                                                                          | 2            | 80 µ | HB MIO epoxy       | 1            | 120 µ | Poly urethane               | 2            | 60 µ | 260µ      |
| 3.    | Insulated parts exposed to temp >120°C                                        | Sa 2 ½              | In organic Zn silicate                                                                  | 2            | 60 µ |                    |              |       |                             |              |      | 60µ       |
| 4.    | Work shop                                                                     | Sa 2 ½              | HB Zn Phospate                                                                          | 2            | 80 µ | HB MIO epoxy       | 1            | 120 µ | Poly urethane               | 2            | 60 µ | 260µ      |
| 5.    | Water Treatment Plant (external)                                              | Sa 2 ½              | Zn rich epoxy                                                                           | 2            | 80 µ | HB MIO epoxy       | 2            | 200 µ | Epoxy PU HB                 | 2            | 80 µ | 360µ      |
| 6.    | Coal Handling Plant                                                           | Sa 2 ½              | HB Zn Phospate                                                                          | 2            | 80 µ | HB MIO epoxy       | 2            | 200 µ | Poly urethane               | 2            | 60 µ | 340µ      |
| 7.    | Coal Fuel pipings                                                             | Sa 2                | Ehthy Zn silicate                                                                       | 1            | 40 µ |                    |              |       | HR aluminium paint          | 2            | 40 µ | 80µ       |
| 8.    | Un insulated silencer, steel stacks >120°C                                    | Sa 2 ½              | Ehthy Zn Silicate                                                                       | 1            | 40 µ |                    |              |       | HR silicone aluminium paint | 2            | 40 µ | 80µ       |
| 9.    | Above ground piping                                                           | Sa 2 ½              | In organic Zn silicate                                                                  | 2            | 80 µ | HB MIO epoxy       | 1            | 120 µ | Poly urethane               | 2            | 60 µ | 260µ      |
| 10.   | Burried piping (external)                                                     | Sa 2 ½              | Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel |              |      |                    |              |       |                             |              |      | 4.0 mm    |
| 11.   | Burried piping (internal)                                                     | Sa 2 ½              | Solid rigid poly urethane 500 µ                                                         |              |      |                    |              |       |                             |              |      | 500µ      |
| 12.   | Storage tanks (external)                                                      | Sa 2 ½              | In organic Zn silicate                                                                  | 2            | 80 µ | HB MIO epoxy       | 2            | 200 µ | Poly urethane               | 2            | 60 µ | 340µ      |
| 13.   | Storage tanks (internal)                                                      | Sa 2 ½              | 3 coats of amine adducts                                                                |              |      |                    |              |       |                             |              |      | 400µ      |
| 14.   | DM water piping (internal)                                                    | Sa 2 ½              | Hard rubber lining min 4 mm thickness                                                   |              |      |                    |              |       |                             |              |      | 4.0       |



1 x 660 MW - Panki Thermal Power Station

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



|     |                                                                     |        |                                                                                   |   |       |              |   |       |                    |   |       | mm   |
|-----|---------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------|---|-------|--------------|---|-------|--------------------|---|-------|------|
| 15. | DM water tank (internal)                                            | Sa 2 ½ | In organic Zn silicate                                                            | 2 | 80 µ  | HB MIO epoxy | 1 | 150 µ | HB coal tar epoxy  | 1 | 150 µ | 380µ |
| 16. | Fuel oil tanks (internal)                                           | Sa 2 ½ | In organic Zn silicate                                                            | 2 | 80 µ  | HB MIO epoxy | 1 | 150 µ | HB coal tar epoxy  | 1 | 150 µ | 380µ |
| 17. | Insulated parts continuously exposed to condensing water            | Sa 2 ½ | In organic Zn silicate                                                            | 2 | 75 µ  |              |   |       |                    |   |       | 75µ  |
| 18. | For insulated piping <125°C                                         | Sa 2 ½ | Polyamide cured epoxy coating                                                     | 2 | 250 µ |              |   |       |                    |   |       | 250µ |
| 19. | Electrical parts, control panels, valves, pumps & motors (indoor)*  | Sa 2 ½ | Zn phosphate epoxy                                                                | 2 | 80 µ  |              |   |       | Chlorinated rubber | 2 | 80 µ  | 160µ |
| 20. | Electrical parts, control panels, valves, pumps & motors (outdoor)* | Sa 2 ½ | Zn phosphate epoxy                                                                | 2 | 80 µ  |              |   |       | Chlorinated rubber | 2 | 100 µ | 180µ |
| 21. | Switch yard, floor grills walk ways                                 | Sa 2 ½ | Hot dip galvanising coating Wt. 610 gms/M <sup>2</sup> (coating thickness of 80µ) |   |       |              |   |       |                    |   |       | 80µ  |

\* **Note:** Manufacturer to specify details of painting system capable of withstanding environmental conditions for a period of 10 years before first maintenance.



## 1X660 MW PANKI THERMAL POWER STATION

List of I/Os required from Motor Controller and Engine Controller

1 No. of I/Os per LT motor are as follows.

|    |   |
|----|---|
| AI | 0 |
| AO | 0 |
| DI | 3 |
| DO | 2 |

2 No. of I/Os per HT motor are as follows.

|    |   |
|----|---|
| AI | 1 |
| AO | 0 |
| DI | 6 |
| DO | 2 |

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

|                                                                                                                                                                                                                                                    |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| <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> | <div>Annexure-6</div> <div>(VOID)</div> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

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

|                                                                                                                                                                                                                                                                                |                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <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>(Foam Pump assembly QAP Guide Line &amp; Formats)</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

|                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                |             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------|
| TD-201<br>Rev No. 00<br>Form No.                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>PRODUCT STANDARD</b><br>PROJECT ENGINEERING & SYSTEMS DIVISION<br>HYDERABAD | ANNEXURE -  |
|                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                | Rev No. 00  |
|                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                | Page 1 of 3 |
| <b>COPYRIGHT AND CONFIDENTIAL</b><br><br>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. | <div>QAP GUIDELINES &amp; FORMAT</div> <div>( ANNEXURE - )</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> |                                                                                |             |

|                                                                                                                                                                                                                                                                            |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                              |                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                            | Form No. | <br>HYDERABAD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p align="center"><b>PRODUCT STANDARD</b></p> <p align="center">PROJECT ENGINEERING &amp; SYSTEMS DIVISION<br/>HYDERABAD</p> | ANNEXURE                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                            |          | Rev No. 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                              |                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                            |          | Page 2 of 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                              |                                                                                                                                                                                                                                                        |
| <p align="center"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p align="center">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.<br/>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>HYDERABAD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p align="center"><b>PRODUCT STANDARD</b></p> <p align="center">PROJECT ENGINEERING &amp; SYSTEMS DIVISION<br/>HYDERABAD</p> | ANNEXURE |
|                                                                                                                                                                                                                                                                            |          | Rev No. 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |          |
|                                                                                                                                                                                                                                                                            |          | Page 3 of 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                              |          |
| <p align="center"><b>COPYRIGHT AND CONFIDENTIAL</b></p> <p align="center">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 code 1.</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.<br>PROJECT:<br>PRODUCT: |               |                  | BHEL P.O.NO.:<br>P.O.DATE:<br>BHEL SPEC: REV: |                  |                  |     | REV NO:         |  | DATE: |         |
|                          |                                             |                 |                                                         |               |                  |                                               |                  |                  |     | 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 CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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: FOAM 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<br>P W V |   |    | REMARKS |
| 1.0                                                                               | RAW MATERIALS & BOUGHT OUT ITEMS   |                                                                         |       |                           |                                                   |                                                 |                  |                   |     |                 |   |    |         |
| 1.1                                                                               | Casing                             | Visual check                                                            | Major | Visual                    | 100%                                              | Tech Spec/ Approved Datasheet/ 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  |         |
| 1.4                                                                               |                                    | Heat treatment for all castings                                         | Major | HT                        | 100%                                              |                                                 |                  | HT chart          | √   | 2               | 2 | 1  |         |
| 1.5                                                                               | Gear and Shaft                     | Chemical & Mech. Properties                                             | Major | Chemical & Mech. analysis | 1 per heat/lot                                    |                                                 |                  | MTC               | √   | 2               | 2 | 1  |         |
| 1.6                                                                               | Mechanical seal                    | Material and leakage check (Air test)                                   | Major | OEM's certificate review  | 100%                                              |                                                 |                  | OEM's certificate | √   | 2               | 2 | 1  |         |
| 1.7                                                                               | Bearing and bearing housing        | Make and Model                                                          | Major | OEM's certificate review  | 100%                                              |                                                 |                  | OEM's certificate | √   | 2               | 2 | 1  |         |
| 1.8                                                                               | Coupling                           | Chemical & Mech. Properties                                             | Major | Chemical & Mech. analysis | 1 per heat/lot                                    |                                                 |                  | MTC               | √   | 2               | 2 | 1  |         |
| 1.9                                                                               | Strainer (as applicable)           | Chemical & Mech. Properties and hydro test                              | Major | OEM's certificate review  | 100%                                              |                                                 |                  | OEM's certificate | √   | 2               | 2 | 1  |         |
| 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  |         |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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.

|                                       |                                                    |                                                                         |          |                                              |                                                   |                                                 |                  |                  |     |                 |   |    |         |
|---------------------------------------|----------------------------------------------------|-------------------------------------------------------------------------|----------|----------------------------------------------|---------------------------------------------------|-------------------------------------------------|------------------|------------------|-----|-----------------|---|----|---------|
| <div>बी एच ई एल</div> <div>BHEL</div> |                                                    | TYPICAL MANUFACTURING QUALITY PLAN                                      |          |                                              |                                                   |                                                 |                  | MQP. NO.:        |     |                 |   |    |         |
|                                       |                                                    | PROJECT ENGINEERING & SYSTEMS<br>DIVISION BHEL,<br>RC PURAM, HYD-502032 |          |                                              | PROJECT:<br>PACKAGE: FOAM PUMP<br>BHEL TECH SPEC: |                                                 |                  | REV NO:          |     | DATE:           |   |    |         |
|                                       |                                                    |                                                                         |          |                                              |                                                   |                                                 |                  | PAGE 2 OF 4      |     |                 |   |    |         |
| 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 |
| 1.11                                  | Interconnecting pipes and fittings (as applicable) | Chemical & Mech. Properties                                             | Major    | Chemical & Mech. Analysis                    | 1 per heat/lot                                    |                                                 |                  | MTC              | √   | 2               | 2 | 1  |         |
| 1.12                                  | Wear rings, Gaskets, Flanges, and Fasteners        | Chemical & Mech. Properties                                             | Minor    | Chemical & Mech. Analysis                    | 1 per heat/lot                                    |                                                 |                  | MTC              | √   | 2               | 2 | 1  |         |
| 2.0                                   | INPROCESS INSPECTION                               |                                                                         |          |                                              |                                                   |                                                 |                  |                  |     |                 |   |    |         |
| 2.1                                   | Fabrication of casing and other components         | WPS, PQR and WQR                                                        | Major    | Document verification                        | 100%                                              | Tech Spec/ Approved Datasheet/ Approved Drawing |                  | WPS, PQR and WQR | --  | 2               | 2 | 1  |         |
| 2.2                                   | Casing                                             | NDE                                                                     | Major    | DPT/MPI                                      | 100%                                              |                                                 |                  | NDE reports      | √   | 2               | 1 | -- |         |
| 2.3                                   |                                                    | Leakage                                                                 | Critical | Hydrostatic test                             | 100%                                              |                                                 |                  | Test reports     | √   | 2               | 1 | -- |         |
| 2.4                                   | Butt welds on casing (if any)                      | NDE                                                                     | Major    | RT                                           | 100%                                              |                                                 |                  | IR               | √   | 2               | 2 | 1  |         |
| 2.5                                   | Fillet welds on casing (if any)                    | NDE                                                                     | Major    | MPI                                          | 100%                                              |                                                 |                  | IR               | √   | 2               | 2 | 1  |         |
| 2.6                                   | Gear                                               | NDE                                                                     | Major    | DPT / MPI                                    | 100%                                              |                                                 |                  | NDE reports      | √   | 2               | 2 | 1  |         |
| 2.7                                   | Shaft                                              | NDE                                                                     | Major    | DPT / MPI and UT (if shaft diameter > 50 mm) | 100%                                              |                                                 |                  | NDE reports      | √   | 2               | 2 | 1  |         |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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: FOAM 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<br>P W V |    |    | REMARKS                                                                                   |
| 2.8                                                                               | Wear rings                                                                         | NDE and hardness test                                                   | Major    | DPT and hardness test | 100%                                              |                                                 |                  | DP and hardness test reports | √   | 2               | 2  | 1  |                                                                                           |
| 2.9                                                                               | Interconnecting Piping (as applicable)                                             | NDE and leakage                                                         | Major    | DPT and hydro test    | 100%                                              |                                                 |                  | DPT and hydro test report    | √   | 2               | 2  | 1  |                                                                                           |
| 2.10                                                                              | Coupling                                                                           | Dynamic balancing                                                       | Critical | Balancing             | 100%                                              |                                                 |                  | IR                           | √   | 2               | 2  | 1  |                                                                                           |
| 2.11                                                                              | Gear                                                                               | Dynamic balancing                                                       | Critical | Balancing             | 100%                                              |                                                 |                  | IR                           | √   | 2               | 2  | 1  |                                                                                           |
| 2.12                                                                              | Gear assembly                                                                      | Dynamic balancing                                                       | Critical | Balancing             | 100%                                              |                                                 |                  | IR                           | √   | 2               | 2  | 1  |                                                                                           |
| 3.0                                                                               | FINAL INSPECTION & TESTING                                                         |                                                                         |          |                       |                                                   |                                                 |                  |                              |     |                 |    |    |                                                                                           |
| 3.1                                                                               | Motor driven pump with job motor and engine driven pump with calibrated shop motor | Overall Dimensions                                                      | Major    | Measurement           | 100%                                              | Tech Spec/ Approved Datasheet/ Approved Drawing |                  | TC                           | √   | 2               | -- | 1  | Only 10% witness by BHEL / BHEL's TPIA, subjective to minimum 1 pump of each size & type. |
| 3.2                                                                               |                                                                                    | Performance test                                                        | Critical | Testing               | 100%                                              |                                                 |                  | IR                           | √   | 2               | 1  | -- |                                                                                           |
| 3.5                                                                               |                                                                                    | Mechanical run test                                                     | Critical | Testing               | 100%                                              |                                                 |                  | TC                           | √   | 2               | 1  | -- |                                                                                           |
| 3.6                                                                               |                                                                                    | Strip Examination                                                       | Major    | Dismantling           | 100%                                              |                                                 |                  |                              |     |                 |    |    |                                                                                           |
| 3.7                                                                               |                                                                                    | Complete unit test with job drives and job accessories.                 | Major    | Testing               | 100%                                              |                                                 |                  | TC                           | √   | 2               | 1  | -- |                                                                                           |
| 3.8                                                                               |                                                                                    | Accessories and Spares (if any)                                         | Major    | BOM check             | 100%                                              |                                                 |                  | IR                           | √   | 2               | 1  | -- |                                                                                           |
| 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/ Approved Drawing |                  | IR                           | √   | 2               | 2  | -- |                                                                                           |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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: FOAM PUMP<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                                  | * D | AGENCY |   |             | REMARKS                                     |
|                                                                                   |            |                                                                         |       |               |                  |                    |                  |                                                   |     | P      | W | V           |                                             |
| 4.2                                                                               |            | Inspection reports/<br>certificate traceability<br>index                | Major | Visual        | 100%             |                    |                  | Index                                             | √   | 2      | 2 | --          |                                             |
| 4.3                                                                               |            | Packing #                                                               | Major | Visual        | 100%             |                    |                  | Packing List                                      | √   | 2      | 2 | --          | # Seaworthy<br>packing for<br>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 CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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<br>P W V | REMARKS |   |  |
| 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 CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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. |                                                              |                                                                                                                                               |       |                                                 |                         |                                                                                                        |                  |                                |     |                 |         |   |  |

|                                                 |                            |                                                                         |       |               |                                                  |                                                                           |                  |                  |     |                 |   |    |         |
|-------------------------------------------------|----------------------------|-------------------------------------------------------------------------|-------|---------------|--------------------------------------------------|---------------------------------------------------------------------------|------------------|------------------|-----|-----------------|---|----|---------|
| <div><div>बी एच ई एल</div><div>BHEL</div></div> |                            | 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 2 OF 4      |     |                 |   |    |         |
| 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 |
| 3.0                                             | FINAL INSPECTION & TESTING |                                                                         |       |               |                                                  |                                                                           |                  |                  |     |                 |   |    |         |
| 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 | -- |         |
| 3.2                                             |                            | SH heater resistance (if applicable)                                    | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.3                                             |                            | Insulation resistance (before and after HV test)                        | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.4                                             |                            | High voltage test at 1.8 KV for 1 minute and space heater HV test       | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.5                                             |                            | Direction of rotation                                                   | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.6                                             |                            | No load test (measurement of NL A, voltage, NL power and NL RPM)        | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.7                                             |                            | Reduced run up voltage test at ( rated volt√3)                          | Major | Testing       | 100%100%                                         |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.8                                             |                            | Locked rotor test at full load current                                  | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.9                                             |                            | Vibration measurement                                                   | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.10                                            |                            | Measurement of noise level                                              | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |
| 3.11                                            |                            | 120% over speed test                                                    | Major | Testing       | 100%                                             |                                                                           |                  | TC               | √   | 2               | 1 | -- |         |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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.

|                                                 |            |                                                                                               |       |               |                                                  |                                                                           |                  |                  |     |                 |    |   |                                                                                             |
|-------------------------------------------------|------------|-----------------------------------------------------------------------------------------------|-------|---------------|--------------------------------------------------|---------------------------------------------------------------------------|------------------|------------------|-----|-----------------|----|---|---------------------------------------------------------------------------------------------|
| <div><div>बी एच ई एल</div><div>BHEL</div></div> |            | 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 3 OF 4      |     |                 |    |   |                                                                                             |
| 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                                                                                     |
| 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 | 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 |                                                                                             |
| 3.14                                            |            | 160% momentary overload test                                                                  | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 |                                                                                             |
| 3.15                                            |            | Locked rotor amp and torque test                                                              | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 |                                                                                             |
| 3.16                                            |            | No load test                                                                                  | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 | 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 |                                                                                             |
| 3.18                                            |            | Insulation resistance test ( before and after HV test)                                        | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 |                                                                                             |
| 3.19                                            |            | HV test – 1.8 KV for winding and 1.5 KV for space heater                                      | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 |                                                                                             |
| 3.20                                            |            | Vibration test                                                                                | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 |                                                                                             |
| 3.21                                            |            | 120% over speed test                                                                          | Major | Testing       | One /rating                                      |                                                                           |                  | TC               | √   | 2               | -- | 1 |                                                                                             |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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 | * D | AGENCY |    |   | REMARKS |
|                                                                                   |                                   |                                                                         |       |                     |                                                  |                                                        |                  |                  |     | P      | W  | V |         |
| 4.0                                                                               | <b>PRESERVATION &amp; PACKING</b> |                                                                         |       |                     |                                                  |                                                        |                  |                  |     |        |    |   |         |
|                                                                                   |                                   | 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 CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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: DIESEL ENGINE<br>BHEL TECH SPEC: |                    |                  | PAGE 1 OF 3      |     |        |   |   |         |
| 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.<br>properties | Major    | Chem. &<br>mech.<br>Testing | 1 per lot/heat | Tech Spec/ Approved Datasheet/<br>Approved Drawing | MTC | √ | 2 | 2 | 1 |  |  |
| 1.2 |                                                             | Crack test                  | Major    | NDE                         | 100%           |                                                    | MTC | √ | 2 | 2 | 1 |  |  |
| 1.3 |                                                             | Dimensions                  | Major    | Measure<br>ment             | 100%           |                                                    | MTC | √ | 2 | 2 | 1 |  |  |
| 1.4 | Cylinder block,<br>Cylinder head,<br>Cylinder liner         | Chem. & mech.<br>properties | Major    | Chem. &<br>mech.<br>Testing | 1 per lot/heat |                                                    | MTC | √ | 2 | 2 | 1 |  |  |
| 1.5 |                                                             | Pressure test               | Major    | Hydro<br>test               | 100%           |                                                    | MTC | √ | 2 | 2 | 1 |  |  |
| 1.6 |                                                             | Dimensions                  | Major    | Measure<br>ment             | 100%           |                                                    | MTC | √ | 2 | 2 | 1 |  |  |
| 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<br>pump and control<br>panel                 | Functional test             | Major    | Testing                     | 100%           |                                                    | TC  | √ | 2 | 2 | 1 |  |  |

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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: DIESEL ENGINE<br>BHEL TECH SPEC: |     |        |   | PAGE 2 OF 3 |                                                                                             |  |
| SL NO                                                                             | COMPONENTS                       | CHARACTERISTICS                                                         | CLASS    | TYPE OF CHECK       | QUANTUM OF CHECK | REFERENCE DOCUMENT                                 | ACCEPTANCE NORMS | FORMAT OF RECORD                                      | * D | AGENCY |   |             | REMARKS                                                                                     |  |
|                                                                                   |                                  |                                                                         |          |                     |                  |                                                    |                  |                                                       |     | P      | W | V           |                                                                                             |  |
| <b>3.0 FINAL INSPECTION &amp; TESTING</b>                                         |                                  |                                                                         |          |                     |                  |                                                    |                  |                                                       |     |        |   |             |                                                                                             |  |
| 3.1                                                                               | Diesel engine                    | Performance test                                                        | Critical | Testing             | 100%             | Tech Spec/ Approved Datasheet/<br>Approved Drawing |                  | TC                                                    | √   | 2      | 1 | --          | Only 10% witness by BHEL / BHEL's TPIA, subjective to minimum 1 engine of each size & type. |  |
| 3.2                                                                               |                                  | Overall Dimensions                                                      | Major    | Measurement         | 100%             |                                                    |                  | IR                                                    | √   | 2      | 1 | --          |                                                                                             |  |
| 3.3                                                                               |                                  | Spares (if any)                                                         | Major    | BOM check           | 100%             |                                                    |                  | IR                                                    | √   | 2      | 1 | --          |                                                                                             |  |
| <b>4.0 PRESERVATION &amp; PACKING</b>                                             |                                  |                                                                         |          |                     |                  |                                                    |                  |                                                       |     |        |   |             |                                                                                             |  |
| 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 | --          | # Seaworthy packing for export orders                                                       |  |
| 4.2                                                                               |                                  | Packing #                                                               | Major    | Visual              | 100%             |                                                    |                  | Packing List                                          | √   | 2      | 2 | 1           |                                                                                             |  |

**Notes:-**

4. This MQP should be read along with specification ((Latest revisions to be considered as per PO), approved drawings & approved datasheet.
5. Specification/drawing/datasheet shall prevail over quality plan for contradiction if any.
6. 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 CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR 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-1         |    |
|                        |                                                                                   |                                                                                                                                              | 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> | <div>Annexure-8</div> <div>(Sub Vendor List)</div> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

| ITEM     | QP/INS<br>P N<br>CAT | QP<br>NO. | ACCEPTABLE<br>SUPPLIER AS PER<br>THE PRESENT<br>DATABASE | PLACE OF<br>MANUFACT<br>URING | SUB-<br>SUPPLIE<br>R<br>APPROV<br>AL<br>STATUS/<br>CATEGO<br>RY | APPROVAL<br>CONDITIONS                                                     |
|----------|----------------------|-----------|----------------------------------------------------------|-------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------|
| STRAINER | I                    |           | OTOKLIN GLOBAL<br>BUSINESS                               | MUMBAI                        | A                                                               |                                                                            |
|          | I                    |           | SAROJINI<br>ENTERPRISE                                   | HOWRAH                        | A                                                               | FOR SIMPLEX<br>STRAINER<br>UPTO 300 NB                                     |
|          | I                    |           | SHIELD                                                   | U K                           |                                                                 |                                                                            |
|          | I                    |           | FILTRATION<br>ENGINEERS                                  | MUMBAI                        | A                                                               |                                                                            |
|          | I                    |           | GRAND PRIX                                               | FARIDABAD                     | A                                                               |                                                                            |
|          | I                    |           | MULTITEX                                                 | NOIDA                         | A                                                               |                                                                            |
|          | I                    |           | GUJARAT<br>OTOFILT                                       | AHMEDABAD                     | A                                                               |                                                                            |
|          | I                    |           | HAWA ENGINEERS<br>LTD.                                   | AHMEDABAD                     | A                                                               |                                                                            |
|          | I                    |           | TRIVENI<br>EQUIPMENTS PVT<br>LTD                         | AHMEDABAD                     | DR                                                              |                                                                            |
|          | I                    |           | H K ENTERPRISES                                          | AHMEDABAD                     | DR                                                              | APPD UP TO<br>SIZES 12" FOR<br>150#,300#,600#,9<br>00#&1500#CLAS<br>S RAT. |
|          | I                    |           | SCIENTIFIC<br>DEVICES<br>(BOMBAY) PVT.<br>LT             | NAVI<br>MUMBAI                | DR                                                              |                                                                            |
|          | I                    |           | MICON VALVES (I)<br>PVT. LTD.                            | MUMBAI                        | DR                                                              |                                                                            |
|          | I                    |           | GRAND PRIX<br>ENGINEERING PVT.<br>LTD                    | FARIDABAD                     | DR                                                              |                                                                            |
|          | I                    |           | JAY-EESH<br>ENGINEERING<br>COMPANY                       | MUMBAI                        | DR                                                              |                                                                            |
|          | I                    |           | SKILT<br>FABRICATORS<br>PVT.LTD,                         | MUMBAI                        | DR                                                              |                                                                            |
|          | I                    |           | NISAN SCIENTIFIC<br>PROCESS                              | NAVI<br>MUMBAI                | DR                                                              |                                                                            |
|          | I                    |           | ASIAN<br>INDUSTRIAL<br>VALVES AND                        | CHENNAI                       | DR                                                              |                                                                            |
|          | I                    |           | SUNGOV<br>ENGINEERING<br>PVT LTD,                        | CHENNAI                       | DR                                                              |                                                                            |
|          | I                    |           | PROCEDYNE<br>ENGINEERS                                   | CHENNAI                       | DR                                                              |                                                                            |
|          | I                    |           | TELEFLO<br>STRAINERS &<br>PRESSURE                       | CHENNAI                       | DR                                                              | APPROVED<br>ONLY FOR<br>CLASS 150<br>RATING UP TO<br>24" SIZE.             |

| Sl. No | Name of Equipment | Vendor Proposed by Bidder                         | Place            | On Provenness/<br>Qualifying exp. | On vendor details |
|--------|-------------------|---------------------------------------------------|------------------|-----------------------------------|-------------------|
| 13     | Battery charger   | Amararaja                                         | Tirupoti         | DR                                | DR                |
|        |                   | Chhabal electrical                                | Jalgaon          | DR                                | DR                |
|        |                   | Chloride Power                                    | Kolkata          | DR                                | DR                |
|        |                   | Dubas                                             | Bangalore        | DR                                | DR                |
|        |                   | Electronic Systems                                | Vadodara         | DR                                | DR                |
|        |                   | Emerson Network Power                             | Thane/ Bangalore | DR                                | DR                |
|        |                   | HBL- Power System                                 | Hyderabad        | DR                                | DR                |
|        |                   | Livefine Electronics                              | Kolkata          | DR                                | DR                |
|        |                   | Mass Tech Controls                                | Jalgaon/ Mumbai  | DR                                | DR                |
|        |                   | Power & Protection                                | Kolkata          | DR                                | DR                |
|        |                   | Servilink Engineers Pvt.Ltd                       | Vadodara         | DR                                | DR                |
|        |                   | Sherene Electro Control Pvt Ltd                   | Mumbai           | DR                                | DR                |
|        |                   | Signatron (India) Pvt Ltd.                        | Kolkata          | DR                                | DR                |
|        |                   | Statcon                                           | Hapur            | DR                                | DR                |
|        |                   | System Aid                                        | Bangalore        | DR                                | DR                |
|        |                   | Universal Industrial Products                     | Mumbai           | DR                                | DR                |
|        |                   | Universal Instruments Manufacturing Co. Pvt. Ltd. | Bangalore        | DR                                | DR                |
|        |                   | Vertiv Energy                                     | Maharashtra      | DR                                | DR                |
|        |                   | Wall Nite Power Systems                           | Singapore        | DR                                | DR                |
|        |                   |                                                   | New Delhi        | DR                                | DR                |

|    |                  |                                 |           |    |    |
|----|------------------|---------------------------------|-----------|----|----|
| 11 | Battery ( Ni-Cd) | M/S HBL-Power System            | Bangalore | DR | DR |
|    |                  | M/S Amosoft                     | Hyderabad | DR | DR |
|    |                  | Amar Raja Batteries             | Bangalore | DR | DR |
|    |                  | Exide Industries Limited        | Tirupathi | DR | DR |
|    |                  | Grid Power Conversion Pvt Ltd.  | Kolkata   | DR | DR |
|    |                  | Signatron (India) Pvt Ltd       | Bangalore | DR | DR |
|    |                  | System Aid                      | Kolkata   | DR | DR |
|    |                  | Hoppecke Batterien GmbH & Co Kg | Bangalore | DR | DR |
|    |                  |                                 |           | DR | DR |

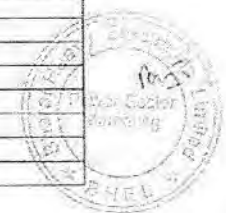
|    |                                           |                                  |                                      |                                 |        |    |                                          |
|----|-------------------------------------------|----------------------------------|--------------------------------------|---------------------------------|--------|----|------------------------------------------|
|    |                                           | PROJECT : UPRVUNL 1x660 MW PANKI |                                      | LIST OF C&I ITEMS REQUIRING QP  |        |    | REVISION NO : 00                         |
|    |                                           | PACKAGE : EPC                    |                                      | APPROVAL & ACCEPTABLE VENDOR AS |        |    | DATE : 03.05.2019                        |
|    |                                           | CONTRACTOR : BHEL                |                                      | APPROVED                        |        |    |                                          |
|    |                                           | CONTRACT NO :                    |                                      |                                 |        |    |                                          |
|    |                                           | I                                | Microprecision                       | PALWAL                          | Note-1 | A  | Approved up to 3600mm size               |
|    |                                           | *                                | Switzer process instrument pvt ltd   | Chennai                         | Note-1 | DR |                                          |
|    |                                           | *                                | TM technomatic SPA                   | Italy                           | Note-1 | DR |                                          |
| 50 | IMPULSE PIPES/TUBES                       |                                  |                                      |                                 |        |    |                                          |
|    |                                           | II                               | Ratnamani Metals and Tubes           | Gandhinagar                     | Note-1 | A  | For SS only                              |
|    |                                           | II                               | Heavy metals and Tubes               | Gandhinagar                     | Note-1 | A  | For SS & CS only.                        |
|    |                                           | II                               | Sumitomo/kawasaki/Nippon             | Japan                           | Note-1 | A  |                                          |
|    |                                           | II                               | TPS TECHNITUBE                       | Germany                         | Note-1 | A  |                                          |
|    |                                           | II                               | Veluric & manessmann                 | Germany                         | Note-1 | A  |                                          |
|    |                                           | II                               | Sandvik                              | SWEDEN                          | Note-1 | A  | For SS only.                             |
|    |                                           | II                               | BHEL                                 | TRICHY                          | Note-1 | A  |                                          |
|    |                                           | *                                | Heavy metals and Tubes               | Mumbai                          | Note-1 | DR |                                          |
|    |                                           | *                                | INDIAN SEAMLESS METAL TUBES LTD      | PUNE                            | Note-1 | DR |                                          |
|    |                                           | *                                | JINDAL SAW LTD                       | CHENNAI                         | Note-1 | DR |                                          |
|    |                                           | *                                | SHUBHLAXMI METALS & TUBES PVT LTD    | MUMBAI                          | Note-1 | DR |                                          |
|    |                                           | *                                | TUBACES                              | SPAIN                           | Note-1 | DR |                                          |
|    |                                           | *                                | SALIZGITTER MANNESMANN INTERNATIONAL | GERMANY                         | Note-1 | DR |                                          |
|    |                                           | *                                | MAXIM TUBES CO PVT LTD               | AHMEDABAD                       | Note-1 | DR |                                          |
|    |                                           | *                                | MBM TUBES PVT LTD                    | CHATTAL, GUJA<br>RAT            | Note-1 | DR |                                          |
|    |                                           | *                                | TUBACEX PRAKASH INDIA PVT LTD        | UMBERGAON<br>GUJARAT            | Note-1 | DR |                                          |
|    |                                           | *                                | SURAJ STAINLESS LIMITED              | AHMEDABAD                       | Note-1 | DR |                                          |
| 51 | Instrument Cables ( F,G<br>& T/C Cables ) |                                  |                                      |                                 |        |    |                                          |
|    |                                           | Note-2                           | Polycab                              | Daman                           | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | Delton                               | Fandabad                        | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | Elkey Teletinks                      | Fandabad                        | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | CORDS                                | Kaharani                        | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | Nicco                                | Kolkata                         | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | Universal Cable                      | Satna                           | Note-1 | A  |                                          |
|    |                                           | Note-2                           | Thermocables                         | Hyderabad<br>/Mahabubnagar      | Note-1 | A  | A, B, F&G                                |
|    |                                           | Note-2                           | Gupta Power Infrastructure Ltd.      | Khurdha                         | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | CMI                                  | Fandabad                        | Note-1 | A  | PVC,FRLS type / 0.5 SQMM F&G TYPE CABLES |
|    |                                           | Note-2                           | Advance Cables Pvt Ltd               | Banglore                        | Note-1 | A  | 0.5 SQMM F&G TYPE CABLES                 |
|    |                                           | Note-2                           | Gemscab Industries Ltd               | Bhiwadi/ Alwar                  | Note-1 | A  | 0.5 SQMM F&G TYPE CABLES                 |
|    |                                           | Note-2                           | T C COMMUNICATION                    | GHAZIABAD                       | Note-1 | A  | PVC,FRLS type                            |
|    |                                           | Note-2                           | TEW & C                              | USA                             | Note-1 | A  |                                          |
|    |                                           | Note-2                           | Habia cables                         | Sweden                          | Note-1 | A  |                                          |
|    |                                           | Note-2                           | Kerpen cables                        | Germany                         | Note-1 | A  |                                          |
|    |                                           | Note-2                           | Lapp cables                          | Germany                         | Note-1 | A  |                                          |
|    |                                           | Note-2                           | Thermo electra Bv                    | Netherland                      | Note-1 | A  |                                          |
|    |                                           | *                                | Thermo electra Bv                    | Hyderabad, India                | Note-1 | DR |                                          |
|    |                                           | *                                | Kerpen cables                        | Germany/<br>Netherlands         | Note-1 | DR |                                          |
|    |                                           | *                                | Lapp cables                          | Germany/ Satna,<br>India        | Note-1 | DR |                                          |



*Handwritten signature*

*Handwritten signature*  
3/6/19

|  |  |                                  |                                            |                                                                               |        |    |                   |  |
|--|--|----------------------------------|--------------------------------------------|-------------------------------------------------------------------------------|--------|----|-------------------|--|
|  |  | PROJECT : UPRVUNL 1x660 MW PANKI |                                            | LIST OF C&I ITEMS REQUIRING QP<br>APPROVAL & ACCEPTABLE VENDOR AS<br>APPROVED |        |    | REVISION NO : 00  |  |
|  |  | PACKAGE : EPC                    |                                            |                                                                               |        |    | DATE : 03.06.2019 |  |
|  |  | CONTRACTOR : BHEL                |                                            |                                                                               |        |    |                   |  |
|  |  | CONTRACT NO :                    |                                            |                                                                               |        |    |                   |  |
|  |  | *                                | Habia cables                               | Sweden/ Germany                                                               | Note-1 | DR |                   |  |
|  |  | *                                | TEW & C                                    | USA/ Germany                                                                  | Note-1 | DR |                   |  |
|  |  | *                                | Elkey Teletinks                            | Kaharani                                                                      | Note-1 | DR |                   |  |
|  |  | *                                | Delton                                     | New Delhi                                                                     | Note-1 | DR |                   |  |
|  |  | *                                | Polycab                                    | Mumbai                                                                        | Note-1 | DR |                   |  |
|  |  | *                                | APAR INDUSTRIES LIMITED                    | GUJARAT/Bangal<br>ore                                                         | Note-1 | DR |                   |  |
|  |  | *                                | ASSOCIATED CABLES PVT LTD                  | ANDHERI(EAST)<br>MUMBAI                                                       | Note-1 | DR |                   |  |
|  |  | *                                | CORDS CABLE INDUSTRIES LTD.                | RAJASTHAN/<br>NEW DELHI                                                       | Note-1 | DR |                   |  |
|  |  | *                                | GUPTA POWER INFRASTRUCTURE LTD.            | BHUBANESWAR                                                                   | Note-1 | DR |                   |  |
|  |  | *                                | LAPP INDIA PVT. LTD.                       | PHASE II,<br>ANEKAL TALUK,<br>BANGALORE                                       | Note-1 | DR |                   |  |
|  |  | *                                | MANSFIELD CABLES COMPANY LTD.              | NOIDA, U.P                                                                    | Note-1 | DR |                   |  |
|  |  | *                                | PARAMOUNT COMMUNICATION LTD                | RAJASTHAN/Secu<br>ndrabadi New<br>Delhi                                       | Note-1 | DR |                   |  |
|  |  | *                                | LEONI CABLE SOLUTIONS (INDIA)              | PUNE                                                                          | Note-1 | DR |                   |  |
|  |  | *                                | TEMSENS CABLE                              | UDAIPUR                                                                       | Note-1 | DR |                   |  |
|  |  | *                                | SERVEL INDIA PVT LTD                       | NEEMRANA/ NEW<br>DELHI                                                        | Note-1 | DR |                   |  |
|  |  | *                                | UDEY PYRO CABLES                           | VADODARA/MUM<br>BAI                                                           | Note-1 | DR |                   |  |
|  |  | *                                | GOYOLENE FIBRES (INDIA) PVT. LTD.          | SILVASSA/<br>MUMBAI                                                           | Note-1 | DR |                   |  |
|  |  | *                                | COROS                                      | KOLKATA/ USA                                                                  | Note-1 | DR |                   |  |
|  |  | *                                | FORBES MARSHALL                            | PUNE                                                                          | Note-1 | DR |                   |  |
|  |  | *                                | NIOON                                      | SWEDEN                                                                        | Note-1 | DR |                   |  |
|  |  | *                                | POISTRONICS                                | VADODRA                                                                       | Note-1 | DR |                   |  |
|  |  | *                                | PROCON                                     | CHENNAI                                                                       | Note-1 | DR |                   |  |
|  |  | *                                | THERMOCATICS                               | INDIA                                                                         | Note-1 | DR |                   |  |
|  |  | *                                | UNIVERSAL INSTRUMENTS MANUFACTURING<br>LTD | INDIA                                                                         | Note-1 | DR |                   |  |
|  |  | *                                | CMI                                        | BHIWADI                                                                       | Note-1 | DR |                   |  |
|  |  | *                                | ALLIED ENGINEERING WORKS PVT               | NEW DELHI                                                                     | Note-1 | DR |                   |  |
|  |  | *                                | GRID INDIA POWER CABLE PVT LTD             | GURGAON                                                                       | Note-1 | DR |                   |  |
|  |  | *                                | KEC INTERNATIONAL                          | MUMBAI                                                                        | Note-1 | DR |                   |  |
|  |  | *                                | N C CABLES PVT LTD                         | NEW DELHI                                                                     | Note-1 | DR |                   |  |
|  |  | *                                | SHYAM CABLE INDUSTRIES                     | NOIDA                                                                         | Note-1 | DR |                   |  |
|  |  | *                                | SRINI LINK                                 | VALSAD                                                                        | Note-1 | DR |                   |  |
|  |  | *                                | TORRENT CABLE                              | AHMEDABAD                                                                     | Note-1 | DR |                   |  |
|  |  | *                                | ULTRACAB (INDIA) LIMITED                   | RAJKOT                                                                        | Note-1 | DR |                   |  |
|  |  | *                                | HIND RECTIFIER LTD                         | INDIA                                                                         | Note-1 | DR |                   |  |
|  |  | *                                | KEI INDUSTRIES LIMITED                     | NEW DELHI India                                                               | Note-1 | DR |                   |  |
|  |  | *                                | UDEY PYRO CABLES                           | Mumbai                                                                        | Note-1 | DR |                   |  |
|  |  | *                                | Thermocables                               | BANGALORE                                                                     | Note-1 | DR |                   |  |
|  |  | *                                | Gemsab Industries Ltd                      | New Delhi/ Alwar                                                              | Note-1 | DR |                   |  |
|  |  | *                                | KEI Industries                             | Chennai                                                                       | Note-1 | DR |                   |  |



*[Handwritten signature]*

*[Handwritten signature]*  
27/6/19

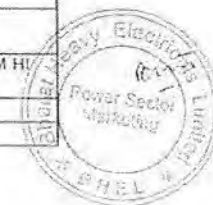
|    |                              |                                  |                                     |                                 |        |    |                                                                          |
|----|------------------------------|----------------------------------|-------------------------------------|---------------------------------|--------|----|--------------------------------------------------------------------------|
|    |                              | PROJECT : UPRVUNL 1x660 MW PANKI |                                     | LIST OF C&I ITEMS REQUIRING QP  |        |    | REVISION NO : 00<br>DATE : 03.06.2013                                    |
|    |                              | PACKAGE : EPC                    |                                     | APPROVAL & ACCEPTABLE VENDOR AS |        |    |                                                                          |
|    |                              | CONTRACTOR :BHEL                 |                                     | APPROVED                        |        |    |                                                                          |
|    |                              | CONTRACT NO :                    |                                     |                                 |        |    |                                                                          |
|    |                              | *                                | KEC INTERNATIONAL LIMITED           | Hyderabad                       | Note-1 | DR |                                                                          |
|    |                              | *                                | MIDDLE EAST SPECIALIZED CABLES CO.  | DUBAI                           | Note-1 | DR |                                                                          |
|    |                              | *                                | PAGODA CABLES PVT. LTD.             | NOIDA                           | Note-1 | DR |                                                                          |
|    |                              | *                                | TOSHNIWAL CABLES PRIVATE LIMITED    | JAIPUR                          | Note-1 | DR |                                                                          |
|    |                              | *                                | Relience Engineering                | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Associated Flexible                 | Pune                            | Note-1 | DR |                                                                          |
|    |                              | *                                | Brooks Cable                        | Mumbai                          | Note-1 | DR |                                                                          |
|    |                              | *                                | SBEE Cable                          | Bangalore                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Rallison Electrical                 | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | IMT Cable                           | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Paras Wires                         | Bangalore                       | Note-1 | DR |                                                                          |
|    |                              | *                                | ShivaPriya cables                   | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Nangalwala industries               | Alwar                           | Note-1 | DR |                                                                          |
|    |                              | *                                | Bhansaki Cables                     | Alwar                           | Note-1 | DR |                                                                          |
|    |                              | *                                | Chandresh Cables                    | Ahemdabad                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Manoj Cables                        | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Sriram Cables                       | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Gloster Cables                      | Secunderabad                    | Note-1 | DR |                                                                          |
|    |                              | *                                | CMI Energy India                    | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Incom Cable                         | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | SUYOG ELECTRICALS LTD               | Vadodara                        | Note-1 | DR |                                                                          |
|    |                              | *                                | SPECIAL CABLES PVT LTD              | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | T C COMMUNICATION                   | New Delhi                       | Note-1 | DR |                                                                          |
|    |                              | *                                | Govind Cable                        | Ghaziabad                       | Note-1 | DR |                                                                          |
|    |                              | *                                | RR Kabel                            | Mumbai                          | Note-1 | DR |                                                                          |
| 52 | INSTRUMENT VALVE(Globe Type) |                                  |                                     |                                 |        |    |                                                                          |
|    |                              | II                               | Instrumentation Limited             | Palakkad                        | Note-1 | A  |                                                                          |
|    |                              | II                               | Excel Hydro                         | Mumbai                          | Note-1 | A  |                                                                          |
|    |                              | II                               | HP Valves and fittings              | CHENNAI                         | Note-1 | A  | FORGED TYPE GLOBE VALVE 1/2"UPTO CLASS 4500 & 1"UPTO CLASS 2500 IBR/NIBR |
|    |                              | II                               | Baldota                             | Mumbai                          | Note-1 | A  |                                                                          |
|    |                              | II                               | Metpress Engineering works          | Kolkata                         | Note-1 | A  | Approved for 1/2" instrument valves (Globe Valve)                        |
|    |                              | III                              | Swagelok                            | USA                             | Note-1 | A  |                                                                          |
|    |                              | III                              | Parker                              | USA                             | Note-1 | A  |                                                                          |
|    |                              | II                               | BHEL                                | TRICHY                          | Note-1 | A  |                                                                          |
|    |                              | *                                | AURA INC                            | DELHI                           | Note-1 | DR |                                                                          |
|    |                              | *                                | PMT ENGINEERS                       | AHMEDABAD                       | Note-1 | DR |                                                                          |
|    |                              | *                                | FLOWTECH                            | KOLKATA                         | Note-1 | DR |                                                                          |
|    |                              | *                                | INSTRUMENTATION LIMITED             | PALGHAT                         | Note-1 | DR |                                                                          |
|    |                              | *                                | HYDAIR LONAVALA                     | LONAVALA                        | Note-1 | DR |                                                                          |
|    |                              | *                                | FLUID CONTROL                       | MUMBAI/PUNE                     | Note-1 | DR |                                                                          |
|    |                              | *                                | DYNA FLUID VALVES AND FLOW CONTROLS | UDYAMBAG,BEL GAUM, KARNATAKA    | Note-1 | DR |                                                                          |
|    |                              | *                                | PRECISION ENGG INDUSTRIES           | MUMBAI                          | Note-1 | DR |                                                                          |



*Handwritten signature*

*Handwritten date: 27/5/19*

|    |                                   |                                  |                                                           |                                                                               |        |    |                                          |  |
|----|-----------------------------------|----------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------|--------|----|------------------------------------------|--|
|    |                                   | PROJECT : UPRVUNL 1x660 MW PANKI |                                                           | LIST OF C&I ITEMS REQUIRING QP<br>APPROVAL & ACCEPTABLE VENDOR AS<br>APPROVED |        |    | REVISION NO : 03                         |  |
|    |                                   | PACKAGE : EPC                    |                                                           |                                                                               |        |    | DATE : 03.06.2019                        |  |
|    |                                   | CONTRACTOR : BHEL                |                                                           |                                                                               |        |    |                                          |  |
|    |                                   | CONTRACT NO :                    |                                                           |                                                                               |        |    |                                          |  |
| 55 | Isolator                          |                                  | Truck/Stahl//P&F/MTL/Wed Muler or OEM<br>approved sources |                                                                               | Note-1 |    | Note-9                                   |  |
| 56 | Large Video Screen<br>(LED Based) |                                  |                                                           |                                                                               |        |    |                                          |  |
|    |                                   | I                                | DELTA                                                     | GURGAON                                                                       | Note-1 | A  |                                          |  |
|    |                                   | I                                | BARCO                                                     | NOIDA                                                                         | Note-1 | A  |                                          |  |
|    |                                   | I                                | PLANAR                                                    | USA                                                                           | Note-1 | A  |                                          |  |
|    |                                   | I                                | Pyrotech Electronics Pvt Ltd                              | UDAIPUR                                                                       | Note-1 | A  |                                          |  |
|    |                                   | *                                | CHRISTIE                                                  | USA                                                                           | Note-1 | DR |                                          |  |
|    |                                   | *                                | Mitsubishi                                                |                                                                               | Note-1 | DR |                                          |  |
|    |                                   | *                                | Eyevis                                                    |                                                                               | Note-1 | DR |                                          |  |
| 57 | LEVEL SWITCH RF TYPE              |                                  |                                                           |                                                                               |        |    |                                          |  |
|    |                                   | II                               | EIP Enviro                                                | Noida                                                                         | Note-1 | A  |                                          |  |
|    |                                   | II                               | FLOW STAR                                                 | Faridabad                                                                     | Note-1 | A  |                                          |  |
|    |                                   | III                              | BHEL                                                      | RANIPET                                                                       | Note-1 | A  |                                          |  |
|    |                                   | *                                | EIP BULK CONTROLS PVT.LTD                                 | NEW DELHI                                                                     | Note-1 | DR |                                          |  |
|    |                                   | *                                | NIVO CONTROLS PVT LTD                                     | INDORE                                                                        | Note-1 | DR |                                          |  |
| 58 | Level switch<br>capacitance type  |                                  |                                                           |                                                                               |        |    |                                          |  |
|    |                                   | III                              | D K Instruments Pvt Ltd                                   | Kolkata                                                                       | Note-1 | A  |                                          |  |
|    |                                   | III                              | ENDRESS & HOUSER                                          | Aurangabad                                                                    | Note-1 | A  |                                          |  |
|    |                                   | III                              | SBEM                                                      | PUNE                                                                          | Note-1 | A  |                                          |  |
|    |                                   | III                              | PUNE TECHTROL                                             | PUNE                                                                          | Note-1 | A  |                                          |  |
|    |                                   | III                              | LEVCON                                                    | KOLKATA                                                                       | Note-1 | A  | Max Operating Temp 80deg C               |  |
|    |                                   | III                              | Nivo Controls                                             | Indore                                                                        | Note-1 | A  |                                          |  |
|    |                                   | III                              | V AUTOMAT                                                 | New Delhi                                                                     | Note-1 | A  |                                          |  |
|    |                                   | III                              | MAGNETROL                                                 | BELGIUM                                                                       | Note-1 | A  |                                          |  |
|    |                                   | *                                | ENDRESS & HOUSER                                          | Switzerland                                                                   | Note-1 | DR |                                          |  |
|    |                                   | *                                | IGEMA GMBH                                                | GERMANY                                                                       | Note-1 | DR |                                          |  |
|    |                                   | *                                | SIEMENS                                                   | GERMANY                                                                       | Note-1 | DR |                                          |  |
|    |                                   | *                                | ABB                                                       | KOREA                                                                         | Note-1 | DR |                                          |  |
|    |                                   | *                                | ROSEMOUNT                                                 | KOREA                                                                         | Note-1 | DR |                                          |  |
| 59 | Level switch- cond type           |                                  |                                                           |                                                                               |        |    |                                          |  |
|    |                                   | III                              | EMERSON (Solartron mobrey) HYDRASTEP                      | UK                                                                            | Note-1 | A  |                                          |  |
|    |                                   | III                              | Yarway                                                    | USA                                                                           | Note-1 | A  |                                          |  |
|    |                                   | III                              | LEVELSTATE                                                | UK                                                                            | Note-1 | A  |                                          |  |
|    |                                   | II                               | Raman Instruments                                         | Delhi                                                                         | Note-1 | A  | FOR EMERSON (MORBREY) UK SYSTEM /        |  |
|    |                                   | II                               | Hi Tech                                                   | Kolkata                                                                       | Note-1 | A  | FOR LEVELSTATE UK SYSTEM /VESSEL FROM HI |  |
|    |                                   | II                               | BHEL                                                      | TRICHY                                                                        | Note-1 | A  | TECH                                     |  |
|    |                                   | *                                | PUNE TECHTROL PVT LTD                                     | PUNE                                                                          | Note-1 | DR |                                          |  |



*Handwritten signature*

*Handwritten date: 7/6/19*

|    |                                                            | PROJECT : UPRVUNL 1x660 MW PANKI |                                    | LIST OF C&I ITEMS REQUIRING QP  |        |    | REVISION NO : 00                      |  |
|----|------------------------------------------------------------|----------------------------------|------------------------------------|---------------------------------|--------|----|---------------------------------------|--|
|    |                                                            | PACKAGE : EPC                    |                                    | APPROVAL & ACCEPTABLE VENDOR AS |        |    | DATE : 03.06.2019                     |  |
|    |                                                            | CONTRACTOR :BHEL                 |                                    | APPROVED                        |        |    |                                       |  |
|    |                                                            | CONTRACT NO :                    |                                    |                                 |        |    |                                       |  |
|    |                                                            | *                                | EMERSON PROCESS MANAGEMENT         | USA                             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | SWAN ANALYTISCHE INSTRUMENTE AG    | SWITZERLAND                     | Note-1 | DR |                                       |  |
|    |                                                            | *                                | WTW                                | GERMANY                         | Note-1 | DR |                                       |  |
|    |                                                            | *                                | DKK                                | JAPAN                           | Note-1 | DR |                                       |  |
|    |                                                            | *                                | YOKOGAWA                           | JAPAN                           | Note-1 | DR |                                       |  |
|    |                                                            | *                                | HONEYWELL                          | USA                             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | THERMO ORION INC.                  | CHELMSFORD                      | Note-1 | DR |                                       |  |
| 86 | SWAS Analyser<br>(Sodium)                                  |                                  |                                    |                                 |        |    |                                       |  |
|    |                                                            | *                                | ABB INDUSTRIES                     | SWITZERLAND                     | Note-1 | DR |                                       |  |
|    |                                                            | *                                | ENDRESS + HAUSER INDIA PVT. LTD    | MUMBAI                          | Note-1 | DR |                                       |  |
|    |                                                            | *                                | HACH LANGE S.A.R.L                 | VESENZ                          | Note-1 | DR |                                       |  |
|    |                                                            | *                                | METTLER-TOLEDO INDIA PVT. LTD.     | POWAI, MUMBAI                   | Note-1 | DR |                                       |  |
|    |                                                            | *                                | EMERSON PROCESS MANAGEMENT         | USA                             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | SWAN ANALYTISCHE INSTRUMENTE AG    | SWITZERLAND                     | Note-1 | DR |                                       |  |
|    |                                                            | *                                | WTW                                | GERMANY                         | Note-1 | DR |                                       |  |
|    |                                                            | *                                | DKK                                | JAPAN                           | Note-1 | DR |                                       |  |
|    |                                                            | *                                | YOKOGAWA                           | JAPAN                           | Note-1 | DR |                                       |  |
|    |                                                            | *                                | HONEYWELL                          | USA                             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | THERMO ORION INC.                  | CHELMSFORD                      | Note-1 | DR |                                       |  |
| 87 | SWAS Analyser<br>(Turbidity)                               |                                  |                                    |                                 |        |    |                                       |  |
|    |                                                            | *                                | ABB INDUSTRIES                     | SWITZERLAND                     | Note-1 | DR |                                       |  |
|    |                                                            | *                                | ENDRESS + HAUSER INDIA PVT. LTD    | MUMBAI                          | Note-1 | DR |                                       |  |
|    |                                                            | *                                | HACH LANGE S.A.R.L                 | VESENZ, SWITZERLAND             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | METTLER-TOLEDO INDIA PVT. LTD.     | POWAI, MUMBAI                   | Note-1 | DR |                                       |  |
|    |                                                            | *                                | EMERSON PROCESS MANAGEMENT         | USA                             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | SWAN ANALYTISCHE INSTRUMENTE AG    | SWITZERLAND                     | Note-1 | DR |                                       |  |
|    |                                                            | *                                | WTW                                | GERMANY                         | Note-1 | DR |                                       |  |
|    |                                                            | *                                | DKK                                | JAPAN                           | Note-1 | DR |                                       |  |
|    |                                                            | *                                | YOKOGAWA                           | JAPAN                           | Note-1 | DR |                                       |  |
|    |                                                            | *                                | HONEYWELL                          | USA                             | Note-1 | DR |                                       |  |
|    |                                                            | *                                | THERMO ORION INC.                  | CHELMSFORD                      | Note-1 | DR |                                       |  |
| 88 | Synchronising Relay                                        |                                  |                                    |                                 |        |    |                                       |  |
|    |                                                            | III                              | Siemens                            | Mumbai                          | Note-1 | A  |                                       |  |
|    |                                                            | III                              | ABB                                | Bangalore                       | Note-1 | A  |                                       |  |
|    |                                                            | III                              | ALSTOM T&D (Earlier Areva)         | Chennai                         | Note-1 | A  |                                       |  |
| 89 | Synchroscope                                               |                                  |                                    |                                 |        |    |                                       |  |
|    |                                                            | III                              | AE                                 | Mumbai                          | Note-1 | A  |                                       |  |
|    |                                                            | III                              | Alstom                             | Chennai                         | Note-1 | A  |                                       |  |
|    |                                                            | III                              | ABB                                | Germany                         | Note-1 | A  |                                       |  |
|    |                                                            | III                              | Reyrolle                           | UK                              | Note-1 | A  |                                       |  |
| 90 | TEMPERATURE<br>ELEMENT(THERMOCOUPLE , RTD &<br>THERMOWELL) |                                  |                                    |                                 |        |    |                                       |  |
|    |                                                            | II                               | Emerson Process Management Pvt Ltd | Pawane                          | Note-1 | A  | Imported from Emerson, Germany (make) |  |



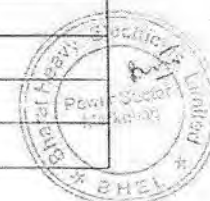
7/6/19

|  |  |                                  |                                         |                                 |        |    |                                                                                                                                         |
|--|--|----------------------------------|-----------------------------------------|---------------------------------|--------|----|-----------------------------------------------------------------------------------------------------------------------------------------|
|  |  | PROJECT : UPRVUNL 1x660 MW PANKI |                                         | LIST OF C&I ITEMS REQUIRING QP  |        |    | REVISION NO : 00                                                                                                                        |
|  |  | PACKAGE : EPC                    |                                         | APPROVAL & ACCEPTABLE VENDOR AS |        |    | DATE : 03.06.2019                                                                                                                       |
|  |  | CONTRACTOR : BHEL                |                                         | APPROVED                        |        |    |                                                                                                                                         |
|  |  | CONTRACT NO :                    |                                         |                                 |        |    |                                                                                                                                         |
|  |  | II                               | Thermal Instruments                     | Savantwadi                      | Note-1 | A  | DUPLEX TYPE RTD                                                                                                                         |
|  |  | II                               | Techno Instruments                      | Ahmedabad                       | Note-1 | A  | 1-Excluding IP Inner casing Thermocouple<br>2. Carrying out N2 leak test for weld closure conformity as per IEC standard on 100 % basis |
|  |  | II                               | Tempsens                                | Udaipur                         | Note-1 | A  |                                                                                                                                         |
|  |  | II                               | Pyroelectric                            | Goa                             | Note-1 | A  | K&R TYPE                                                                                                                                |
|  |  | II                               | Detrv Instrumentation & Electronics Ltd | Mumbai                          | Note-1 | A  |                                                                                                                                         |
|  |  | III                              | Minco                                   | USA                             | Note-1 | A  |                                                                                                                                         |
|  |  | III                              | OKAZAKI                                 | JAPAN                           | Note-1 | A  |                                                                                                                                         |
|  |  | III                              | Yaman                                   | JAPAN                           | Note-1 | A  | THERMOCOUPLE ASSEMBLY WITH THERMOWELL                                                                                                   |
|  |  | III                              | Yaman                                   | Singapore                       | Note-1 | A  | Thermocouple (Up to 1100 Deg. C)K&R TYPE                                                                                                |
|  |  | III                              | EMERSON PROCESS MANAGEMENT              | Germany                         | Note-1 | A  | RTD, TC AND THERMOWELL                                                                                                                  |
|  |  | III                              | HERAUS SENSOR                           | GERMANY                         | Note-1 | A  |                                                                                                                                         |
|  |  | III                              | WASE Control                            | Korea                           | Note-1 | A  |                                                                                                                                         |
|  |  | III                              | Thermosensor                            | Germany                         | Note-1 | A  |                                                                                                                                         |
|  |  | III                              | Gauges Burdon                           | Panvel                          | Note-1 | A  |                                                                                                                                         |
|  |  | II                               | TOSHNIWAL INDUSTRIES                    | AJMER                           | Note-1 | A  |                                                                                                                                         |
|  |  | II                               | WKA Instruments India Pvt Ltd           | PUNE                            | Note-1 | A  |                                                                                                                                         |
|  |  | *                                | CARLO DYNATECH                          | INDIA                           | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | EMERSON (ROSEMOUNT)                     | DAMAN                           | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | FABRIKA                                 | INDIA                           | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | EXOTHERM INSTRUMENTS MUMBAI             | MUMBAI                          | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | GOA INSTRUMENTS INDUSTRIES PVT LTD      | GOA                             | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | INDUSTRIAL INSTRUMENTATION              | KOTA/ KOLKATA                   | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | ABB (SENSYCON)                          | GERMANY                         | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | ALTOP INDUSTRIES LTD.                   | India                           | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | E&H                                     | AURANGABAD                      | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | NESSTECH INSTRUMENTS PVT LTD            | VAPI                            | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | PYRO ELECTRIC INSTRUMENTS               | GOA, India                      | Note-1 | DR |                                                                                                                                         |
|  |  | *                                | RESISTANCE ALLOYS (INDIA                | MUMBAI, India                   | Note-1 | DR |                                                                                                                                         |



*Handwritten signature and date 27/6/19*

|    |                                          |     |                                   |                                                                               |        |    |                                                                                  |  |
|----|------------------------------------------|-----|-----------------------------------|-------------------------------------------------------------------------------|--------|----|----------------------------------------------------------------------------------|--|
|    |                                          |     | PROJECT : UPRVUNL 1x660 MW PANKI  | LIST OF C&I ITEMS REQUIRING QP<br>APPROVAL & ACCEPTABLE VENDOR AS<br>APPROVED |        |    | REVISION NO : 00                                                                 |  |
|    |                                          |     | PACKAGE : EPC                     |                                                                               |        |    | DATE : 03.05.2019                                                                |  |
|    |                                          |     | CONTRACTOR : BHEL                 |                                                                               |        |    |                                                                                  |  |
|    |                                          |     | CONTRACT NO :                     |                                                                               |        |    |                                                                                  |  |
|    |                                          | *   | SIEMENS INDIA                     | GURGAON                                                                       | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | ELEIND ENGG                       | NOIDA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | JINDAL ELECTRONICS                | ROORKEE                                                                       | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | BAUMER                            | VAPI                                                                          | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | EMERSON (ROSEMOUNT)               | GERMANY                                                                       | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | HONEYWELL                         | USA/INDIA                                                                     | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | MASIBUS AUTOMATION                | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | MICROPRECISION                    | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | NAVDIRGA FORGINGS & FITTINGS      | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | PRECISION ENGINEERING             | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | PRECISION MASS                    | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | TC LTD                            | USA                                                                           | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | TECHNO INSTRUMENTS                | AHMDABAD                                                                      | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | THERMO ELECTRIC                   | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | TM TECHNOMATIC                    | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | VALUE TREK ENGINEERS              | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | WALCHANDER INDUSTRIES LTD         | INDIA                                                                         | Note-1 | DR |                                                                                  |  |
|    |                                          | *   | Process Control                   | Roorkee                                                                       | Note-1 | DR |                                                                                  |  |
| 91 | TEMPERATURE<br>GAUGE(WITH<br>THERMOWELL) |     |                                   |                                                                               |        |    |                                                                                  |  |
|    |                                          | III | Baumer                            | Vapi                                                                          | Note-1 | A  |                                                                                  |  |
|    |                                          | III | Precision mass products Pvt. Ltd. | Gandhinagar                                                                   | Note-1 | A  | MASS AND ASHCROFT BRAND WITH ALL<br>COMPONENTS IMPORTED FROM ASHCROFT<br>GERMANY |  |
|    |                                          | III | Wika                              | Pune                                                                          | Note-1 | A  |                                                                                  |  |
|    |                                          | III | Forbes Marshall                   | Hyderabad                                                                     | Note-1 | A  | upto 6" dial size. Gasfilled Type                                                |  |
|    |                                          | III | Goa Instrument Industries         | Goa                                                                           | Note-1 | A  |                                                                                  |  |
|    |                                          | III | Goa Thermostatic                  | Goa                                                                           | Note-1 | A  | MIS AND INERT GAS TYPE                                                           |  |
|    |                                          | III | H GURU INDUSTRIES                 | Rishra/Muzaffarpur                                                            | Note-1 | A  |                                                                                  |  |
|    |                                          | III | BUDENBERG                         | UK                                                                            | Note-1 | A  |                                                                                  |  |
|    |                                          | III | DRESSOR (ASHCROFT)                | USA/Germany                                                                   | Note-1 | A  |                                                                                  |  |
|    |                                          | III | Wika                              | GERMANY                                                                       | Note-1 | A  |                                                                                  |  |



*Handwritten signature*

*Handwritten signature and date 7/2/19*

|    |                         |                                  |                                            |                                                                               |        |    |                                                                                          |
|----|-------------------------|----------------------------------|--------------------------------------------|-------------------------------------------------------------------------------|--------|----|------------------------------------------------------------------------------------------|
|    |                         | PROJECT : UPRVUNL 1x660 MW PANKI |                                            | LIST OF C&I ITEMS REQUIRING QP<br>APPROVAL & ACCEPTABLE VENDOR AS<br>APPROVED |        |    | REVISION NO : 00                                                                         |
|    |                         | PACKAGE : EPC                    |                                            |                                                                               |        |    | DATE : 03.06.2019                                                                        |
|    |                         | CONTRACTOR : BHEL                |                                            |                                                                               |        |    |                                                                                          |
|    |                         | CONTRACT NO :                    |                                            |                                                                               |        |    |                                                                                          |
|    |                         | III                              | H.Guru South India                         | Bangalore                                                                     | Note-1 | A  |                                                                                          |
|    |                         | III                              | Nagano KEIKI                               | Japan                                                                         | Note-1 | A  |                                                                                          |
|    |                         | III                              | Nesstech Instruments Pvt Ltd               | Vapi                                                                          | Note-1 | A  | Gas filled type 600 deg C, Gas filled & Thermowell up to 130 Ksc                         |
|    |                         | III                              | NUOVA FIMA                                 | ITALY                                                                         | Note-1 | A  |                                                                                          |
|    |                         | III                              | WMSE Control                               | Korea                                                                         | Note-1 | A  |                                                                                          |
|    |                         | III                              | Walchandnagar Industries                   | DHARWAD                                                                       | Note-1 | A  |                                                                                          |
|    |                         | *                                | Gauges Bourdon (GIC)                       | Panvel                                                                        | Note-1 | DR |                                                                                          |
|    |                         | *                                | KONICS                                     | KOREA                                                                         | Note-1 | DR |                                                                                          |
|    |                         | *                                | H.GURU Instruments (P) Ltd.                | NEW DELHI                                                                     | Note-1 | DR |                                                                                          |
|    |                         | *                                | General Instruments Consortium             | MUMBAI                                                                        | Note-1 | DR |                                                                                          |
|    |                         | *                                | A.N.INSTRUMENTS PVT LTD                    | KOLKATA                                                                       | Note-1 | DR |                                                                                          |
|    |                         | *                                | Pressure & Temperature Control Instruments | KOLKATA                                                                       | Note-1 | DR |                                                                                          |
|    |                         | *                                | PYROELECTRIC                               | GOA                                                                           | Note-1 | DR |                                                                                          |
|    |                         | *                                | TEMPSENS INSTRUMENTS (I) PVT.LTD.,         | UDAIPUR,India                                                                 | Note-1 | DR |                                                                                          |
|    |                         | *                                | JUMO INDIA PVT LTD                         | INDIA                                                                         | Note-1 | DR |                                                                                          |
|    |                         | *                                | THERMAL INSTRUMENT INDIA PVT. LTD          | Savanthawadi                                                                  | Note-1 | DR |                                                                                          |
|    |                         | *                                | US GAUGE                                   | USA                                                                           | Note-1 | DR |                                                                                          |
|    |                         | *                                | WINTERS GAUGE                              | GOA/ USA                                                                      | Note-1 | DR |                                                                                          |
| 92 | TEMPERATURE TRANSMITTER |                                  |                                            |                                                                               |        |    |                                                                                          |
|    |                         | III                              | ENDRESS & HOUSER                           | Aurangabad                                                                    | Note-1 | A  |                                                                                          |
|    |                         | III                              | Emerson Process management Pvt Ltd         | Pawane                                                                        | Note-1 | A  | Dual input & multi-input imported from Singapore but tagged & configured at Pawane works |
|    |                         | III                              | ABB                                        | Bangalore                                                                     | Note-1 | A  | DIN RAIL DUAL I/P FIELD MOUNTED TYPE ( MAKE M/S ABB GERMANY )                            |
|    |                         | III                              | Yokogawa                                   | Japan                                                                         | Note-1 | A  |                                                                                          |
|    |                         | III                              | Moore                                      | USA                                                                           | Note-1 | A  |                                                                                          |
|    |                         | III                              | M System co ltd                            | JAPAN                                                                         | Note-1 | A  | Model No-B3HU-0                                                                          |
|    |                         | III                              | EMERSON                                    | U.S.A/Singapore                                                               | Note-1 | A  |                                                                                          |
|    |                         | III                              | ABB                                        | GERMANY                                                                       | Note-1 | A  |                                                                                          |
|    |                         | III                              | ABB                                        | BANGALORE                                                                     | Note-1 | A  | ASSEMBLED TT PROCURED FROM ABB,GERMANY                                                   |
|    |                         | *                                | KHRONE                                     | FRANCE                                                                        | Note-1 | DR |                                                                                          |
|    |                         | *                                | TOKYO KIESO                                | JAPAN                                                                         | Note-1 | DR |                                                                                          |
|    |                         | *                                | HONEYWELL AUTOMATION                       | PUNE                                                                          | Note-1 | DR |                                                                                          |
|    |                         | *                                | INOR                                       | SWEDEN                                                                        | Note-1 | DR |                                                                                          |



|                                                                                                                                                                                                                                 |                                                                    |                                  |                                  |                                                                               |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------|----------------------------------|-------------------------------------------------------------------------------|-------------------|
|                                                                                                                                                                                                                                 |                                                                    | PROJECT : UPRVUNL 1x660 MW PANKI |                                  | LIST OF C&I ITEMS REQUIRING QP<br>APPROVAL & ACCEPTABLE VENDOR AS<br>APPROVED | REVISION NO : 00  |
|                                                                                                                                                                                                                                 |                                                                    | PACKAGE : EPC                    |                                  |                                                                               | DATE : 03.05.2019 |
|                                                                                                                                                                                                                                 |                                                                    | CONTRACTOR : BHEL                |                                  |                                                                               |                   |
|                                                                                                                                                                                                                                 |                                                                    | CONTRACT NO :                    |                                  |                                                                               |                   |
| MC-37                                                                                                                                                                                                                           | PRESSURE TRANSMITTER (PRESSURE, DP, FLOW, LEVEL APPLICATION)       | III                              | Main Contractor Approved Sources | AC/ESP/FDPS                                                                   |                   |
| MC-38                                                                                                                                                                                                                           | Printer (Dot Matrix)                                               | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-39                                                                                                                                                                                                                           | Printer (Inkjet / Laser)                                           | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-40                                                                                                                                                                                                                           | PSYCHROMETER                                                       | III                              | Main Contractor Approved Sources | CT                                                                            |                   |
| MC-41                                                                                                                                                                                                                           | Pulse jet Controller                                               | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-42                                                                                                                                                                                                                           | Pulse Valve                                                        | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-43                                                                                                                                                                                                                           | Residual Chlorine Analyser                                         | III                              | Main Contractor Approved Sources | WTP                                                                           |                   |
| MC-44                                                                                                                                                                                                                           | ROTAMETER                                                          | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-45                                                                                                                                                                                                                           | Semaphore Indicators                                               | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-46                                                                                                                                                                                                                           | SIGHT FLOW INDICATOR                                               | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-47                                                                                                                                                                                                                           | SINGLE AND MULTI POINT TEMPERATURE RECORDER (Microprocessor based) | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-48                                                                                                                                                                                                                           | SMART POSITIONER                                                   | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-49                                                                                                                                                                                                                           | Socket Weld Fittings                                               | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-50                                                                                                                                                                                                                           | SOLENOID VALVE                                                     | III                              | Main Contractor Approved Sources | AC/AHP/CHP/CWP/FDPS/HYD PLANT /MILL REJ/STATION PIPING                        |                   |
| MC-51                                                                                                                                                                                                                           | Solid Mass Flow Meter                                              | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-52                                                                                                                                                                                                                           | SV BOX                                                             | III                              | Main Contractor Approved Sources | CHP/WTP                                                                       |                   |
| MC-53                                                                                                                                                                                                                           | Temperature cum Humidity Indicator                                 | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-54                                                                                                                                                                                                                           | TEMPERATURE SWITCH                                                 | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-55                                                                                                                                                                                                                           | Transducer                                                         | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-56                                                                                                                                                                                                                           | Tube thickness Meter                                               | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-57                                                                                                                                                                                                                           | Turbidity Analyser                                                 | III                              | Main Contractor Approved Sources | WTP                                                                           |                   |
| MC-58                                                                                                                                                                                                                           | Voltmeter                                                          | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-59                                                                                                                                                                                                                           | Watthour Meters                                                    | III                              | Main Contractor Approved Sources | ALL PACKAGES                                                                  |                   |
| MC-60                                                                                                                                                                                                                           | SMF LEAD-ACID BATTERY FOR MICROPROCESSOR BASED FIRE ALARM PANEL    | III                              | Main Contractor Approved Sources | FDPS                                                                          |                   |
| LEGENDS :                                                                                                                                                                                                                       |                                                                    |                                  |                                  |                                                                               |                   |
| 1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY                                                                                                                                                                     |                                                                    |                                  |                                  |                                                                               |                   |
| A - For those items proposed vendor is acceptable to Customer. To be indicated with letter "A" in the list along with the condition of approval, if any.                                                                        |                                                                    |                                  |                                  |                                                                               |                   |
| DR - For those items "Detailed Required" for Customer review. To be identified with letter "DR" in the list. For these items, vendor shall be proposed for owner acceptance with-in the agreed contract schedule of the package |                                                                    |                                  |                                  |                                                                               |                   |
| SQP-Standard Quality Plan                                                                                                                                                                                                       |                                                                    | RQP-Reference Quality Plan       |                                  |                                                                               |                   |
| 2.0 QP INSPECTION CATEGORY :                                                                                                                                                                                                    |                                                                    |                                  |                                  |                                                                               |                   |

*Nse*

*7/5/19*



|                                  |                                 |                   |
|----------------------------------|---------------------------------|-------------------|
| PROJECT : UPRVUNL 1x660 MW PANKI | LIST OF C&I ITEMS REQUIRING QP  | REVISION NO : 00  |
| PACKAGE : EPC                    | APPROVAL & ACCEPTABLE VENDOR AS | DATE : 03.06.2019 |
| CONTRACTOR : BHEL                | APPROVED                        |                   |
| CONTRACT NO :                    |                                 |                   |

CAT - I : For those items the Quality Plans are approved by Customer and final acceptance will be on physical inspection witness by Customer

CAT - II : For those items the Quality Plans are approved by Customer. However no physical inspection shall be done by Customer. The final acceptance by Customer shall be on the basis of review of documents.

CAT - III : For these items Quality control to be exercised as per Main contractor Quality Assurance System. The final acceptance by Owner shall be on the basis of Certificate of Conformance (COC) by main contractor

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units/works.

\* - Inspection category will be decided during vendor evaluation.

NOTE - 1 : Approval is conditional and subject to Sub QR / Provenances clearance as specified in the contract specification. Further for any change in the Technical specification at later stage vendor approval will be reviewed accordingly.

NOTE - 2 : For Instrument cable <= 1 KM inspection category CAT - III, For > 1 KM to <= 10 KM inspection category CAT - II GOC & FOR > 10 KM inspection category CAT-I

NOTE - 3 : For Fiber Optic cable <= 10KM inspection category CAT - III & for > 10KM inspection category CAT-II

NOTE-4 : Batteries for UPS <= 10 KVA and batteries for intelligent battery charger 24 V DC <= 40 Amp inspection category CAT-III & for Batteries for UPS > 10KVA and batteries for intelligent battery charger 24 V DC > 40 Amp rating inspection category CAT-I

NOTE-5 : UPS <= 10 KVA rating inspection category CAT-III & for > 10KVA rating inspection category CAT-I

NOTE - 6 : For the items not appearing in the preaward list and falls in the scope of supply of the bidder, bidder and Customer will mutually discussed in future.

NOTE - 7 - EMPTY CABINETS, COMPUTERS, SIGNAL ISOLATOR/ MULTIPLIER and TB SHALL ALSO BE ACCEPTABLE FROM OWNER ACCEPTED IN QP. IF THE TOTAL INTEGRATED PANEL AND FAT IS CONDUCTED INDEGENEOUSLY

NOTE-8 : For the C & I Instruments mounted on the skid of the main item or supplied as a integral part of the main item, instrument to be supplied as per proven practice of the manufacturer meeting the Customer technical specification requirement.

NOTE-9- This item is a bought out component of main equipments like DDCMS, PLC, TSI, CCTV, PA system etc

NOTE-10- For these controlled items, vendor shall be proposed for owner acceptance with-in the agreed contract schedule of the package

*N Aganwal*  
N Aganwal  
(QA- Consultant)

*5/6/19*  
(S.N. Mishra)



|                                                                                  |                                                                                |  |  |  |  |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--|--|--|--|
|  | <b>CORPORATE QUALITY ASSURANCE</b><br><b>MAIN CONTRACTOR EVALUATION REPORT</b> |  |  |  |  |
|                                                                                  |                                                                                |  |  |  |  |

|                                                                                                                                                                 |                                                                                                                                                                                                                                                                              |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------|
| i.                                                                                                                                                              | Main Contractor                                                                                                                                                                                                                                                              |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| ii.                                                                                                                                                             | Project                                                                                                                                                                                                                                                                      |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| iii.                                                                                                                                                            | Package Name                                                                                                                                                                                                                                                                 |                                                                                                |                                                                                                |                                                         | Package No                                                                          |                   |
| iv.                                                                                                                                                             | Proposed Item/Scope of Sub-contracting                                                                                                                                                                                                                                       |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| v.                                                                                                                                                              | Item covered under                                                                                                                                                                                                                                                           | Schedule-1                                                                                     |                                                                                                |                                                         | As per contract clause No-                                                          |                   |
|                                                                                                                                                                 |                                                                                                                                                                                                                                                                              | Schedule-2                                                                                     |                                                                                                |                                                         |                                                                                     |                   |
| vi.                                                                                                                                                             | If item is Schedule-1 and proposed sub-vendor is indigenous, Main Contractor to explain how the contractual provisions will be fulfilled-                                                                                                                                    |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| vii.                                                                                                                                                            | Name and Address of the proposed Sub-vendor's works                                                                                                                                                                                                                          |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| viii.                                                                                                                                                           | PO placement date/ Start of manufacturing (if self-manufactured) as per L2 network                                                                                                                                                                                           |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| ix.                                                                                                                                                             | Item Description<br>(Type/Size/Rating/Scope of Sub-Contracting)                                                                                                                                                                                                              | Total quantity of proposed item envisaged in this package (Nos/ Running Meters/ Kgs/ Tons etc) | Quantity proposed to be procured from proposed sub-vendor (Nos/ Running Meters /Kgs /Tons etc) | Per month quantity requirements as per project schedule | Actual monthly production capacity viz-a-viz the monthly proposed order requirement |                   |
|                                                                                                                                                                 |                                                                                                                                                                                                                                                                              |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| x.                                                                                                                                                              | Supply experience of the proposed sub-vendor (including supplies to Main Contractor, if any) for similar item/scope of sub-contracting, for last 3 years ( <i>Note:- Only relevant experience details wrt proposed item/scope of subcontracting to be brought out here</i> ) |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
|                                                                                                                                                                 | Project/Package                                                                                                                                                                                                                                                              | Customer Name                                                                                  | Supplied Item<br>(Type/Rating/Model /Capacity/Size etc)                                        | PO ref<br>no/date                                       | Supplied<br>Quantity                                                                | Date of<br>Supply |
|                                                                                                                                                                 |                                                                                                                                                                                                                                                                              |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| We confirm that as per our assessment, the proposed sub-vendor has requisite capabilities and supply experience for the proposed item/scope of sub-contracting. |                                                                                                                                                                                                                                                                              |                                                                                                |                                                                                                |                                                         |                                                                                     |                   |
| Name:                                                                                                                                                           |                                                                                                                                                                                                                                                                              |                                                                                                | Desig:                                                                                         |                                                         | Sign:                                                                               | Date:             |

Company's Seal/Stamp:-

Format No. : QS-01-QAI-P-04/F1-R3

1/1

Engg. div./QA&I

|                                                                                  |                                                                       |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|  | <b>CORPORATE QUALITY ASSURANCE</b><br><b>SUB-VENDOR QUESTIONNAIRE</b> |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------|

|             |                                                                                                                                                                                   |                                                                                                                                                                 |  |  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <b>i.</b>   | <b>Item/Scope of Sub-contracting</b>                                                                                                                                              |                                                                                                                                                                 |  |  |
| <b>ii.</b>  | <b>Address of the registered office</b>                                                                                                                                           | <b>Details of Contact Person</b><br>(Name, Designation, Mobile, Email)                                                                                          |  |  |
| <b>iii.</b> | <b>Name and Address of the proposed Sub-vendor's works where item is being manufactured</b>                                                                                       | <b>Details of Contact Person:</b><br>(Name, Designation, Mobile, Email)                                                                                         |  |  |
| <b>iv.</b>  | <b>Annual Production Capacity for proposed item/scope of sub-contracting</b>                                                                                                      |                                                                                                                                                                 |  |  |
| <b>v.</b>   | <b>Annual production for last 3 years for proposed item/scope of sub-contracting</b>                                                                                              |                                                                                                                                                                 |  |  |
| <b>vi.</b>  | <b>Details of proposed works</b>                                                                                                                                                  |                                                                                                                                                                 |  |  |
| 1.          | <b>Year of establishment of present works</b>                                                                                                                                     |                                                                                                                                                                 |  |  |
| 2.          | <b>Year of commencement of manufacturing at above works</b>                                                                                                                       |                                                                                                                                                                 |  |  |
| 3.          | <b>Details of change in Works address in past (if any)</b>                                                                                                                        |                                                                                                                                                                 |  |  |
| 4.          | <b>Total Area</b>                                                                                                                                                                 |                                                                                                                                                                 |  |  |
|             | <b>Covered Area</b>                                                                                                                                                               |                                                                                                                                                                 |  |  |
| 5.          | <b>Factory Registration Certificate</b>                                                                                                                                           | <b>Details attached at Annexure – F2.1</b>                                                                                                                      |  |  |
| 6.          | <b>Design/ Research &amp; development set-up</b><br>(No. of manpower, their qualification, machines & tools employed etc.)                                                        | <b>Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design</b><br><b>Details attached at Annexure – F2.2</b><br>(if applicable) |  |  |
| 7.          | <b>Overall organization Chart with Manpower Details</b><br>(Design/Manufacturing/Quality etc)                                                                                     | <b>Details attached at Annexure – F2.3</b>                                                                                                                      |  |  |
| 8.          | <b>After sales service set up in India, in case of foreign sub-vendor</b><br>(Location, Contact Person, Contact details etc.)                                                     | <b>Applicable / Not applicable</b><br><br><b>Details attached at Annexure – F2.4</b>                                                                            |  |  |
| 9.          | <b>Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any</b> | <b>Details attached at Annexure – F2.5</b>                                                                                                                      |  |  |

|                                                                                  |                                                                       |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|  | <b>CORPORATE QUALITY ASSURANCE</b><br><b>SUB-VENDOR QUESTIONNAIRE</b> |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------|

| 10.                                                                                                                                                                                                                                                                                                                                  | Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing                                                                                                                                                                                                                                                                                                                                                                      | Details attached at Annexure – F2.6                                                    |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------|---------------------------------------------------------|----------------|-------------------|----------------|--|-------|--|--|--|--|--|
| 11.                                                                                                                                                                                                                                                                                                                                  | Manufacturing facilities<br>(List of machines, special process facilities, material handling etc.)                                                                                                                                                                                                                                                                                                                                                                     | Details attached at Annexure – F2.7                                                    |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 12.                                                                                                                                                                                                                                                                                                                                  | Testing facilities<br>(List of testing equipment)                                                                                                                                                                                                                                                                                                                                                                                                                      | Details attached at Annexure – F2.8                                                    |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 13.                                                                                                                                                                                                                                                                                                                                  | If manufacturing process involves fabrication then-<br>List of qualified Welders<br>List of qualified NDT personnel with area of specialization                                                                                                                                                                                                                                                                                                                        | Applicable / Not applicable<br>Details attached at Annexure – F2.9<br>(if applicable)  |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 14.                                                                                                                                                                                                                                                                                                                                  | List of out-sourced manufacturing processes with Sub-Vendors' names & addresses                                                                                                                                                                                                                                                                                                                                                                                        | Applicable / Not applicable<br>Details attached at Annexure. –F2.10<br>(if applicable) |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 15.                                                                                                                                                                                                                                                                                                                                  | Supply reference list including recent supplies                                                                                                                                                                                                                                                                                                                                                                                                                        | Details attached at Annexure – F2.11<br>(as per format given below)                    |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                      | <table border="1" style="width: 100%;"> <tr> <th style="width: 10%;">Project/<br/>package</th> <th style="width: 10%;">Customer<br/>Name</th> <th style="width: 30%;">Supplied Item (Type/Rating/Model<br/>/Capacity/Size etc)</th> <th style="width: 20%;">PO ref no/date</th> <th style="width: 20%;">Supplied Quantity</th> <th style="width: 10%;">Date of Supply</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table> | Project/<br>package                                                                    | Customer<br>Name | Supplied Item (Type/Rating/Model<br>/Capacity/Size etc) | PO ref no/date | Supplied Quantity | Date of Supply |  |       |  |  |  |  |  |
| Project/<br>package                                                                                                                                                                                                                                                                                                                  | Customer<br>Name                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Supplied Item (Type/Rating/Model<br>/Capacity/Size etc)                                | PO ref no/date   | Supplied Quantity                                       | Date of Supply |                   |                |  |       |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 16.                                                                                                                                                                                                                                                                                                                                  | Product satisfactory performance feedback<br>letter/certificates/End User Feedback                                                                                                                                                                                                                                                                                                                                                                                     | Attached at annexure - F2.12                                                           |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 17.                                                                                                                                                                                                                                                                                                                                  | Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product<br>(similar or higher rating)<br>Note:- Reports need not to be submitted                                                                                                                                                                                                                                                                                  | Applicable / Not applicable<br>Details attached at Annexure – F2.13<br>(if applicable) |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 18.                                                                                                                                                                                                                                                                                                                                  | Statutory / mandatory certification for the proposed product                                                                                                                                                                                                                                                                                                                                                                                                           | Applicable / Not applicable<br>Details attached at Annexure – F2.14<br>(if applicable) |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 19.                                                                                                                                                                                                                                                                                                                                  | Copy of ISO 9001 certificate<br>(if available)                                                                                                                                                                                                                                                                                                                                                                                                                         | Attached at Annexure – F2.15                                                           |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| 20.                                                                                                                                                                                                                                                                                                                                  | Product technical catalogues for proposed item (if available)                                                                                                                                                                                                                                                                                                                                                                                                          | Details attached at Annexure – F2.16                                                   |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        |                  |                                                         |                |                   |                |  |       |  |  |  |  |  |
| <table border="1" style="width: 100%;"> <tr> <td style="width: 15%;">Name:</td> <td style="width: 30%;"> </td> <td style="width: 15%;">Desig:</td> <td style="width: 30%;"> </td> <td style="width: 10%;">Sign:</td> <td style="width: 15%;"> </td> <td style="width: 10%;">Date:</td> <td style="width: 15%;"> </td> </tr> </table> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        | Name:            |                                                         | Desig:         |                   | Sign:          |  | Date: |  |  |  |  |  |
| Name:                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Desig:                                                                                 |                  | Sign:                                                   |                | Date:             |                |  |       |  |  |  |  |  |

Company's Seal/Stamp:-

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

|                                                                                                                                                                                                                                                    |                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| <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-9</h1> <h2>(MASTER DOCUMENT LIST)</h2> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

**Annexure-9: MASTER DOCUMENT LIST - Foam 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:                                                     | Foam Pump   |              |         |                    | TODAY-DATE                    | 28/May/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             | Motor GA Drawing                                                    | Later       |              | A       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 14             | Motor Data Sheet                                                    | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 15             | Motor Characteristics Curve                                         | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 16             | Controller GA Drawing & Wiring Diagram for Motor Controller         | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 17             | Diesel engine GA Drawing                                            | Later       |              | A       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 18             | Diesel engine Data Sheet                                            | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 19             | Controller GA Drawing & Wiring Diagram for Diesel Engine Controller | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 20             | Diesel Engine Wiring Diagram                                        | Later       |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 21             | Battery Charger Data Sheet                                          | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 22             | Battery Data Sheet                                                  | Later       |              | A       | Y                  | Y                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 23             | Battery capacity calculation sheet                                  | Later       |              | I       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |
| 24             | Fuel tank Drawing                                                   | Later       |              | A       | Y                  | N                             | Within 2 weeks after PO placement |                        |                 |                           |    |         |

**Annexure-9: MASTER DOCUMENT LIST - Foam 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:                                            | Foam Pump   |              |         |                    | TODAY-DATE                    | 28/May/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 |
| 25    | Fuel tank calculation sheet                                | Later       |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                 |                           |    |         |
| 27    | Coupling GA Drawing for Motor Driven Pump                  | Later       |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                 |                           |    |         |
| 28    | Coupling GA Drawing for Engine Driven Pump                 | Later       |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                 |                           |    |         |
| 29    | Mechanical Seal GA Drawing and details: Motor driven Pump  | Later       |              | I       | Y                  | N                             | Within 2 weeks after PO placement  |                        |                 |                           |    |         |
| 30    | 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 Field Instruments                            | Later       |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                 |                           |    |         |
| 2     | Data Sheet of Level Transmitter/Switch and 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     | Vibration test procedure & Temperature rise test procedure | Later       |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 3     | Hydro Test Procedure                                       | Later       |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 4     | NDE Test Procedure                                         | Later       |              | I       | N                  | N                             | Within 8 weeks after PO placement  |                        |                 |                           |    |         |
| 5     | Painting proccedure                                        | Later       |              | A       | N                  | N                             | Within 10 weeks after PO placement |                        |                 |                           |    |         |
| 6     | Packing List                                               | Later       |              | I       | N                  | N                             | Before Despatch                    |                        |                 |                           |    |         |
| 7     | BILL OF MATERIAL                                           | Later       |              | A       | N                  | N                             | Within 10 weeks after PO placement |                        |                 |                           |    |         |
| 8     | BILLING BREAKUP                                            | Later       |              | A       | N                  | N                             | Before Despatch                    |                        |                 |                           |    |         |
| 9     | QUALITY ASSURANCE PLAN                                     | Later       |              | A       | N                  | Y                             | Within 4 weeks after PO placement  |                        |                 |                           |    |         |
| 10    | SUB VENDOR LIST                                            | Later       |              | I       | N                  | N                             | Within 4 weeks after PO placement  |                        |                 |                           |    |         |
| 11    | COMMISSIONING SPARES LIST                                  | Later       |              | A       | N                  | N                             | Within 4 weeks after PO placement  |                        |                 |                           |    |         |
| 12    | Mandatory Spares List                                      | Later       |              | A       | N                  | N                             | Within 4 weeks after PO placement  |                        |                 |                           |    |         |

**Annexure-9: MASTER DOCUMENT LIST - Foam 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:                                                                                        | Foam Pump                            |              |         |                    | TODAY-DATE                    | 28/May/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 |
| 13    | LUBE OIL SCHEDULE                                                                                      | Later                                |              | I       | N                  | N                             | Within 8 weeks after PO placement                    |                        |                 |                                        |    |         |
| 14    | O& M Manuals(Soft Copies)                                                                              | Later                                |              | A       | N                  | N                             | After Approval of all engineering drawings/documents |                        |                 |                                        |    |         |
| 15    | 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 incor |    |         |
|       |                                                                                                        | PC- Pending with Customer            |              |         |                    |                               | TOTAL "PC"                                           |                        | 0               | A3-Commented.Revision & resubmissio    |    |         |
|       |                                                                                                        | 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 | Submited 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-1         |    |
|                        |                                                                                                                                                                     |                                                                                                                                              | 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-10</h1> <h2>(DEVIATION FORMAT)</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

**ANNEXURE-10: DEVIATION FORMAT**

| <b>Sl. No.</b> | <b>Section / Part/Subsection</b> | <b>Page No.</b> | <b>Clause No.</b> | <b>Bid Specification Requirement</b> | <b>Bidder's Deviation</b> |
|----------------|----------------------------------|-----------------|-------------------|--------------------------------------|---------------------------|
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |
|                |                                  |                 |                   |                                      |                           |

**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-1         |    |
|                        |                                                                                   |                                                                                                                                              |  | 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-11</h1> <h2>(PREBID CLARIFICATION FORMAT)</h2> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|

|                                                   |  |  |  |  |
|---------------------------------------------------|--|--|--|--|
| <b>Revisions:</b><br>Refer to record of revisions |  |  |  |  |
|                                                   |  |  |  |  |

### 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.