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| <b><u>SR.NO</u></b> | <b><u>DESCRIPTION</u></b> | <b><u>HFO</u><br/><u>TRANSFERRING</u><br/><u>PUMP</u></b> | <b><u>LDO</u><br/><u>TRANSFERRING</u><br/><u>PUMP</u></b> |
|---------------------|---------------------------|-----------------------------------------------------------|-----------------------------------------------------------|
| 39.0                | Relief valve body         | Yes                                                       | Yes                                                       |
| 40.0                | Relief valve spring       | Yes                                                       | Yes                                                       |
| 41.0                | Gasket                    | Yes                                                       | Yes                                                       |
| 42.0                | All fasteners             | Yes                                                       | Yes                                                       |

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| <p style="text-align: center;"><b><u>MAT COIL HEATER</u></b></p> <p style="text-align: center;"><b><u>DATA SHEET-A</u></b></p>                       |                                                        |   |                                                                                                                                        |
| <b>SR.NO</b>                                                                                                                                         | <b>DESCRIPTION</b>                                     |   |                                                                                                                                        |
| 1.0                                                                                                                                                  | No                                                     | : | 1 x 100% (sectionalized to two or three sections.)                                                                                     |
| 2.0                                                                                                                                                  | Capacity                                               | : | As per design requirement                                                                                                              |
| 3.0                                                                                                                                                  | Margin on surface area over requirement to be provided | : | 25%                                                                                                                                    |
| 4.0                                                                                                                                                  | Tube side design pressure                              | : | Max expected working pressure i.e. set pressure of relief valve of PRV + accumulation.                                                 |
| 5.0                                                                                                                                                  | Tube side hydraulic test pressure                      | : | 1.5 times of design pressure                                                                                                           |
| 6.0                                                                                                                                                  | Types of tubes used                                    | : | Seamless as per ASTM – A 106 Gr.B                                                                                                      |
| 7.0                                                                                                                                                  | Temp.                                                  | : | Temp. of HFO in tank to be raised to 50 <sup>0</sup> C in 36 hours.                                                                    |
| 8.0                                                                                                                                                  | Accessories                                            | : | Inlet/Outlet valves, steam trap etc.                                                                                                   |
| 9.0                                                                                                                                                  | Supports                                               | : | From tank bottom side. Suitable additional plate shall be provided on tank shell/bottom. Direct welding to shell/bottom not permitted. |
| <p>* Set pressure of relief valve shall be 1.1 times (minimum) of working pressure (3.5 kg/sq.cm g) of carrying fluid.</p>                           |                                                        |   |                                                                                                                                        |

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### **FUEL OIL HANDLING PUMPS**

#### **DATASHEET – A**

| <b><u>SR. NO.</u></b> | <b><u>DESCRIPTION</u></b>               | <b><u>UNIT</u></b> | <b><u>HFO PUMP</u></b>            | <b><u>LDO PUMP</u></b>            |
|-----------------------|-----------------------------------------|--------------------|-----------------------------------|-----------------------------------|
| <b>1.0</b>            | Service                                 |                    | Fuel Oil                          | Fuel Oil                          |
| <b>2.0</b>            | Duty                                    |                    | Continuous                        | Continuous                        |
| <b>3.0</b>            | Location                                |                    | Indoor                            | Indoor                            |
| <b>4.0</b>            | No. of Pumps                            | No.                | Two (2)<br>(1W+1S)                | Two (2)<br>(1W+1S)                |
| <b>5.0</b>            | Type of Oil to be Handled               |                    | Heavy Fuel Oil                    | Light Diesel Oil                  |
| <b>6.0</b>            | Characteristics of Oil                  |                    | Refer Volume II                   | Refer Volume II                   |
| <b>7.0</b>            | Site Working Condition                  |                    | Refer Volume II                   | Refer Volume II                   |
| <b>8.0</b>            | Handling temperature                    | °C                 | 60 ± 5°C                          | 8 to 45°C                         |
| <b>9.0</b>            | Installation                            |                    | Horizontal with external bearing  | Horizontal with external bearing  |
| <b>10.0</b>           | Type                                    |                    | Rotary positive Displacement type | Rotary positive Displacement type |
| <b>11.0</b>           | (a) Design Capacity at lowest viscosity |                    | *                                 | *                                 |
|                       | (b) Rated capacity at handling          |                    | *                                 | *                                 |

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| <u><b>SR. NO.</b></u>                                                                                                                                                                  | <u><b>DESCRIPTION</b></u>                                 | <u><b>UNIT</b></u> | <u><b>HFO PUMP</b></u>                   | <u><b>LDO PUMP</b></u>                   |
|                                                                                                                                                                                        | temperature                                               |                    |                                          |                                          |
|                                                                                                                                                                                        | (c) Differential Pressure corresponding to rated capacity |                    | *                                        | *                                        |
|                                                                                                                                                                                        | (d) Pump rated TDH                                        |                    | *                                        | *                                        |
| 12.0                                                                                                                                                                                   | Pump Speed                                                | RPM                | 1500                                     | 1500                                     |
| 13.0                                                                                                                                                                                   | Suction Condition                                         |                    | Flooded                                  | Flooded                                  |
| 14.0                                                                                                                                                                                   | Accessories to be provided                                |                    |                                          |                                          |
| 14.1                                                                                                                                                                                   | (a) Relief valves                                         |                    | Yes                                      | Yes                                      |
|                                                                                                                                                                                        | (b) Type                                                  |                    | Inbuilt adjustable set pressure type     | Inbuilt adjustable set pressure type     |
|                                                                                                                                                                                        | (c) Value of set pressure of relief valve                 |                    | 1.1 times of rated differential pressure | 1.1 times of rated differential pressure |
| 14.2                                                                                                                                                                                   | Mechanical Seal                                           |                    | Yes                                      | Yes                                      |
| 14.3                                                                                                                                                                                   | Lubrication                                               |                    | External grease lubricated               | External grease lubricated               |
| 14.4                                                                                                                                                                                   | Body steam jacketed                                       |                    | Yes                                      | No                                       |
| 14.5                                                                                                                                                                                   | Timing Gear                                               |                    | Yes                                      | Yes                                      |
| 14.6                                                                                                                                                                                   | Suction & discharge pressure gauge connection             |                    | Yes                                      | Yes                                      |

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| <b><u>SR. NO.</u></b>                                                                                                                                | <b><u>DESCRIPTION</u></b>                                          | <b><u>UNIT</u></b> | <b><u>HFO PUMP</u></b> | <b><u>LDO PUMP</u></b> |
| 14.7                                                                                                                                                 | Suction temperature gauge connection                               |                    | Yes                    | Yes                    |
| 14.8                                                                                                                                                 | Other accessories if required for cooling/sealing/lubrication etc. |                    | Yes                    | Yes                    |
| 14.9                                                                                                                                                 | Bearing                                                            |                    | Yes                    | Yes                    |
| 14.10                                                                                                                                                | Base plate                                                         |                    | Yes                    | Yes                    |
| 14.11                                                                                                                                                | Lifting lug/eye bolts etc.                                         |                    | Yes                    | Yes                    |
| 14.12                                                                                                                                                | Tools & tackle and spare parts                                     |                    | Yes                    | Yes                    |
| 14.13                                                                                                                                                | Shop Painting                                                      |                    | Yes                    | Yes                    |
| <b>15.0</b>                                                                                                                                          | <b><u>MATERIAL OF CONSTRUCTION</u></b>                             |                    |                        |                        |
| 15.1                                                                                                                                                 | Casing                                                             |                    | Cast iron              | Cast iron              |
| 15.2                                                                                                                                                 | Casing liner                                                       |                    | Cast iron              | Cast iron              |
| 15.3                                                                                                                                                 | Rotor                                                              |                    | ASTM-A-276 type 431    | ASTM-A-276 type 431    |
| 15.4                                                                                                                                                 | Rotor Housing                                                      |                    | Mild Steel             | Mild Steel             |
| 15.5                                                                                                                                                 | Shaft                                                              |                    | EN 8                   | EN 8                   |
| 15.6                                                                                                                                                 | Mechanical seal                                                    |                    | 30% chrome steel       | 30% chrome steel       |
| 15.7                                                                                                                                                 | Reduction gear                                                     |                    |                        |                        |
|                                                                                                                                                      | (a) Body                                                           |                    | Cast iron              | Cast iron              |
|                                                                                                                                                      | (b) Gears                                                          |                    | EN-8                   | EN-8                   |
| 15.8                                                                                                                                                 | Coupling                                                           |                    | Cast iron              | Cast iron              |

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| <b><u>SR. NO.</u></b> | <b><u>DESCRIPTION</u></b> | <b><u>UNIT</u></b> | <b><u>HFO PUMP</u></b> | <b><u>LDO PUMP</u></b> |
|-----------------------|---------------------------|--------------------|------------------------|------------------------|
| 15.9                  | Base plate                |                    | Mild steel             | Mild steel             |
| 15.10                 | Relief valve body         |                    | SS                     | SS                     |
| 15.11                 | Relief valve spring       |                    | SS                     | SS                     |
| 15.12                 | Gasket                    |                    | Graphite<br>Asbestos   | Graphite<br>asbestos   |
| 15.13                 | All Fastener              |                    | SS-304                 | SS-304                 |

**NOTE:**

- 1.0 All Cast iron and Mild steel shall conform to relevant ASTM Standards.
- 2.0 \*Bidder to indicate.

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### **HFO HEATERS**

### **DATA SHEET – A**

| <u><b>SR.NO.</b></u> | <u><b>DESCRIPTION</b></u>              | <u><b>UNITS</b></u>       |                                 |
|----------------------|----------------------------------------|---------------------------|---------------------------------|
| <b>1.0</b>           | <u><b>GENERAL</b></u>                  |                           |                                 |
| 1.1                  | Type                                   |                           | Horizontal, shell and tube type |
| 1.2                  | Nos. of Heaters                        | Nos.                      | Two (02) (1W+1S)                |
| 1.3                  | Liquid handled                         |                           | Heavy Fuel Oil (HFO)            |
| 1.4                  | Location                               |                           | Indoor                          |
| 1.5                  | Design codes                           |                           | TEMA (Class "R"), HEI, ASME     |
| <b>2.0</b>           | <u><b>PERFORMANCE REQUIREMENTS</b></u> |                           |                                 |
| 2.1                  | Heating Fluid                          |                           | Auxiliary steam                 |
| 2.1.1                | Pressure                               | Kg/cm <sup>2</sup><br>(g) | 3.5                             |
| 2.1.2                | Temperature                            | °C                        | 150                             |
| 2.1.3                | Quantity                               | T/hr                      | 8                               |
| 2.1.4                | Design Pressure                        | Kg/cm <sup>2</sup><br>(g) | 9                               |
| 2.1.5                | Design Temperature                     | °C                        | 180                             |
| 2.2                  | Fouling resistance to be considered    |                           |                                 |
| 2.2.1                | Design oil pressure                    | Kg/cm <sup>2</sup><br>(g) | 24                              |
| 2.2.2                | Design oil inlet temperature           | °C                        | 60                              |

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| <u>SR.NO.</u>                                                                                                                                        | <u>DESCRIPTION</u>                                 | <u>UNITS</u> |                                                       |
| 2.2.3                                                                                                                                                | Final oil temperature                              |              | *                                                     |
| 2.3                                                                                                                                                  | Maximum allowable pressure drop on shell side      | MLC          | 5                                                     |
| <b>3.0</b>                                                                                                                                           | <b><u>MATERIAL OF CONSTRUCTION</u></b>             |              |                                                       |
| 3.1                                                                                                                                                  | Shell                                              |              | SA 285 Gr. C or superior as per manufacturer standard |
| 3.2                                                                                                                                                  | Shell cover                                        |              | SA 285 Gr. C or superior as per manufacturer standard |
| 3.3                                                                                                                                                  | Tubes                                              |              | SA 285 Gr. C or superior as per manufacturer standard |
| 3.4                                                                                                                                                  | Tube sheet                                         |              | SA 515 Gr. 70                                         |
| 3.5                                                                                                                                                  | Channel & Channel cover                            |              | SA 285 Gr. C or superior as per manufacturer standard |
| <b>4.0</b>                                                                                                                                           | <b><u>SAFETY VALVE</u></b>                         |              |                                                       |
| 4.1                                                                                                                                                  | Safety valve set pressure                          |              | *                                                     |
| 4.2                                                                                                                                                  | Safety valve particular                            |              | Cast steel flanged                                    |
| <b>5.0</b>                                                                                                                                           | Vent & drain valve at channel side provided        |              | Yes                                                   |
| <b>6.0</b>                                                                                                                                           | Vent & drain valve at shell side provided          |              | Yes                                                   |
| <b><u>NOTE:</u></b><br><br>1.0      *Bidder to indicate.                                                                                             |                                                    |              |                                                       |

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| 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CODES AND STANDARDS                                    |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RESPONSIBILITY FOR DESIGN                              |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 3.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | NAME PLATES (RATING PLATES)                            |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 4.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SAFETY AND SECURITY                                    |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 5.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | GUARDS                                                 |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 6.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | LOCATION AND LAYOUT REQUIREMENTS                       |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 7.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OPERATION, MAINTENANCE AND AVAILABILITY CONSIDERATIONS |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 8.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | MATERIALS                                              |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 9.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | LUBRICATION                                            |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 10.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | LUBRICANTS & CONTROL FLUIDS                            |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 11.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | OPERATION AND MAINTENANCE                              |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 12.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PLANT LIFE AND MODE OF OPERATION                       |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 13.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PACKAGING & MARKING                                    |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 14.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PROTECTION                                             |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 15.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PAINTING                                               |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 16.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | COLOUR CO-ORDINATION AND FINISH                        |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 17.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT     |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 18.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | INSPECTION AND TESTING                                 |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |
| 19.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | TRAINING OF OWNER'S PERSONNEL                          |                |                          |                           |     |                     |     |                           |     |                             |     |                     |     |        |     |                                  |     |                                                        |     |           |     |             |      |                             |      |                           |      |                                  |      |                     |      |            |      |          |      |                                 |      |                                                    |      |                        |      |                               |

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| <u><b>CLAUSE NO.</b></u>                                                                                                                                                                                                                                                                                                                                               | <u><b>DESCRIPTION</b></u>                          |                |                          |                           |            |                                 |            |                     |            |                                         |            |                                |
| ANNEXURE–A                                                                                                                                                                                                                                                                                                                                                             | LIST OF STANDARDS FOR REFERENCE                    |                |                          |                           |            |                                 |            |                     |            |                                         |            |                                |
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| ANNEXURE–D                                                                                                                                                                                                                                                                                                                                                             | SPECIFIC LAYOUT CONSIDERATIONS                     |                |                          |                           |            |                                 |            |                     |            |                                         |            |                                |

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| <br><b>MAHAGENCO</b><br>Maharashtra State Power Generation Co. Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: II            |
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| <p><b>1.0      <u>CODES AND STANDARDS</u></b></p> <p>1.1      Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the Annexure to this Section and mentioned in detailed Specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible, had there been a Standard Specification.</p> <p>1.2      Where the Bidder proposes alternative codes or standards, he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.</p> <p>1.3      Wherever specified or required, the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Bidder.</p> <p>1.4      In the event of any conflict between the codes and standards referred above and the requirements of this specification, the requirements, which are more stringent, shall govern.</p> <p>1.5      In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing, the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.</p> <p>1.6      Successful Bidder shall furnish two (2) sets of latest of national/international codes and standards to owner.</p> |                                                    |                       |

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| <br><b>MAHAGENCO</b><br><small>Maharashtra State Power Generation Co. Ltd.</small>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: II            |
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| <p><b>2.0      <u>RESPONSIBILITY FOR DESIGN</u></b></p> <p>2.1      The Bidder shall assume full responsibility for the design of the whole and every part of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.</p> <p>2.2      Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar or more arduous conditions elsewhere, at least for continuous two (2) years in two different power stations.</p> <p>2.3      The successful bidder shall have to carry out surge analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.</p> <p>2.4      The Bid shall include a detailed discussion on the development status of and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.</p> <p>2.5      The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back etc are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions etc shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.</p> <p><b>3.0      <u>NAME PLATES (RATING PLATES)</u></b></p> <p>3.1      Instruction plates, nameplates or labels shall be permanently attached to each main and auxiliary item of Plant in a conspicuous position. These plates shall</p> |                                                    |                       |

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|                                                                                                                                                      | <p>be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of Plant has been designed to operate.</p>                                                                                                                                                                                                                                                                                                    |                       |
| 3.2                                                                                                                                                  | <p>Items such as valves etc which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.</p>                                   |                       |
| 3.3                                                                                                                                                  | <p>All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.</p>                                                                                                                                                                                                                                                                                                                                                                         |                       |
| 3.4                                                                                                                                                  | <p>The size and location of nameplates shall be subject to Approval of the Engineer.</p>                                                                                                                                                                                                                                                                                                                                                                                                |                       |
| <b>4.0</b>                                                                                                                                           | <b><u>SAFETY AND SECURITY</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                       |
| 4.1                                                                                                                                                  | <p>The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.</p> |                       |
| 4.2                                                                                                                                                  | <p>Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.</p>                                                                                                                                                                                                                                                                                                                                      |                       |
| 4.3                                                                                                                                                  | <p>Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localize and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA and TAC etc as necessary shall be followed in all respects.</p>                                        |                       |
| 4.4                                                                                                                                                  | <p>The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall</p>                                                                                                                                                                                                                                                                                                                         |                       |

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| <br><b>MAHAGENCO</b><br>Maharashtra State Power Generation Co. Ltd.                                                                                                                                                                                                                                                                                                                               | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b>                                                                                                                                                                                                                                                                                                                                    | Volume: II     |
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| <p>minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.</p> |                                                                                                                                                                                                                                                                                                                                                                                       |                |
| <b>5.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b><u>GUARDS</u></b>                                                                                                                                                                                                                                                                                                                                                                  |                |
| 5.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.                                                                                                                                                                                                                                                                          |                |
| 5.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance. |                |
| 5.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.                                                                                                                                                   |                |
| 5.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.                                                                                                                                                                                                              |                |
| 5.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.                                                                                                     |                |
| <b>6.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b><u>LOCATION AND LAYOUT REQUIREMENTS</u></b>                                                                                                                                                                                                                                                                                                                                        |                |
| <p>The majority of plant and equipment shall all be of indoor installation. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment / components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria</p>                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                       |                |

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| <br><b>MAHAGENCO</b><br><small>Maharashtra State Power Generation Co. Ltd.</small>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: II            |
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| <p>given under the various equipment and system specifications as well as those stipulated in Annexure-B attached to this section.</p> <p>Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the powerhouse as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.</p> <p>Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner / Engineer find the proposal more attractive in terms of techno-economic consideration.</p> <p>6.1 While developing the layout of buildings the following criteria shall be given effect:</p> <p>6.1.1 The minimum width of clear access corridors around equipment shall be one (1) meter.</p> <p>6.1.2 Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.</p> <p>6.1.3 The plinth level with respect to the existing grade level shall be as indicated elsewhere in this specification. Finished Grade Level (FGL) above Mean Sea Level (MSL) for the plant area, CHP area and for PWS area inside plant to be developed. Mean sea level for the plant is 210 m.</p> <p>6.1.4 The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of two (2) meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.</p> |                                                    |                       |

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| 6.1.5                                                                                                                                                | <p>There shall be at least two (2) main access doors, one on either side of each building, of which one shall be minimum three (3) meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.</p> |                       |
| 6.1.6                                                                                                                                                | <p>All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.</p>                                                                                                                                                                                                 |                       |
| 6.1.7                                                                                                                                                | <p>All rail/road crossings for pipe/cable racks shall be done with minimum Seven (7) meters headroom from top of rail/road to bottom of rack. Similarly, top cover over underground pipes/cables shall be minimum one (1) meter.</p>                                                                                                                                                                                                                                                         |                       |
| 6.1.8                                                                                                                                                | <p>Cubicle for operating personnel shall be located at safe place near the equipment.</p>                                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| 6.1.9                                                                                                                                                | <p>Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.</p>                                                                                                                                                                                                                                                                                                                                                                                   |                       |
| 6.1.10                                                                                                                                               | <p>Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered as far as possible. Any departure from this suggestive layout is primarily not recommended.</p>                                                                                                                                                                                                         |                       |
| 6.2                                                                                                                                                  | <p>The following requirements for equipment layout shall be complied with:</p>                                                                                                                                                                                                                                                                                                                                                                                                               |                       |
| 6.2.1                                                                                                                                                | <p>The regular basement floor is not acceptable in Boiler &amp; Mill Bunker bay building. Further, local pits/trenches shall be avoided as far as possible.</p>                                                                                                                                                                                                                                                                                                                              |                       |
| 6.2.2                                                                                                                                                | <p>Mills shall be located by the side of Boiler. The width of Mill/Bunker building shall be 12.5 M and the length of the same shall be 10.5 M per Mill. A clear walkway of 1200 mm (min) shall be ensured between the mills/ its foundation/ mill reject vessel edge and inner face of mill bay column. Raw coal bunker shall be circular in shape unless otherwise approved.</p>                                                                                                            |                       |

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| 6.2.3                                                                                                                                                | Interconnecting walkways (minimum 2 m width) between main plant building and boiler (on either side of boiler) at Ground, Mezzanine, Operating, PRDS and Deaerator floor levels shall be provided. Also inter-connecting platform between Boiler and Coal Tripper floor level and roof of Mill maintenance floor level, Feeder floor level, Bunker Building at Mill bay shall be provided. Number of interconnecting platforms between Boiler and Coal Bunker building for each level / floor specified above shall be two (2) on each side of Boiler i.e. four (4)/floor. |                       |
| 6.2.4                                                                                                                                                | Two of the landing levels of the Goods Elevator shall preferably coincide with the feeder and tripper floor elevations. In case of difference in levels, electric hoists to shift goods from elevator floors to feeder/ tripper floors shall be provided.                                                                                                                                                                                                                                                                                                                  |                       |
| 6.2.5                                                                                                                                                | Fuel Oil (F.O.) piping shall be routed over trestles. The headroom for F.O. trestle in Boiler/ESP/ID fan/Chimney area shall be 8.0 M till the road behind chimney and 7.0 M in CD bay area. The headroom for F.O. trestle in outlying area shall be 3.0 M except at rail/road crossing where the headroom shall be 8.0 M.                                                                                                                                                                                                                                                  |                       |
| 6.2.6                                                                                                                                                | Clear walkways along A-row & B-row of TG building shall be provided as indicated below: <ul style="list-style-type: none"> <li>(a) 1.5 m at all levels of AB Bay.</li> <li>(b) 3.5 m along B-row at operating floor level for interconnection with service Building &amp; in front of control room.</li> </ul>                                                                                                                                                                                                                                                             |                       |
| 6.2.7                                                                                                                                                | The layout of the steam turbine unit shall permit sufficient lay down area for all the parts/components to enable carrying out maintenance and overhauling operations.                                                                                                                                                                                                                                                                                                                                                                                                     |                       |
| 6.2.8                                                                                                                                                | Steam turbine and generator (except stator) and other equipments located in the turbine hall shall be accessible by the EOT cranes for their handling during erection and maintenance. For all other equipment/components, suitable handling arrangement for erection and maintenance shall be provided.                                                                                                                                                                                                                                                                   |                       |

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| 6.2.9                                                                                                                                                | In TG bay at crane rail level, walkway with handrails is envisaged for entire column sectional depth for full length of the building. In addition, it shall be ensured that on A-row and B-row columns, through walkway (without hindrance) of minimum 600 mm clear width is available from the face of the column to the handrail of the platform.                                                   |                       |
| 6.2.10                                                                                                                                               | Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipments, piping, cabling, duct routed in the area.                                                                                                                                                                                              |                       |
| 6.2.11                                                                                                                                               | Adequate space and handling arrangement shall be provided for handling/removal of pumps, heaters, heat-exchanger, fans, mills during maintenance.                                                                                                                                                                                                                                                     |                       |
| 6.2.12                                                                                                                                               | Valves shall be located in accessible positions and operating/maintenance platforms shall be provided along with approach ladders & handrails for the same.                                                                                                                                                                                                                                           |                       |
| 6.2.13                                                                                                                                               | While developing the layout, all fresh air ventilation louvers shall be considered 1000 mm from floor level and directed downwards at an angle. Ventilation fans on AB bay roof shall be kept staggered and shall not be near the centerline of turbo generator set.                                                                                                                                  |                       |
| 6.2.14                                                                                                                                               | Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory Act and Statuary bodies/Insurance companies.                                                                                                                                                                                                                                      |                       |
| 6.2.15                                                                                                                                               | All other safety requirements as per the factories Act, Rules/regulations made under Electricity Act, 2003 and applicable codes/standards shall be observed while developing the layout.                                                                                                                                                                                                              |                       |
| <b>7.0</b>                                                                                                                                           | <b><u>OPERATION, MAINTENANCE &amp; AVAILABILITY CONSIDERATIONS</u></b>                                                                                                                                                                                                                                                                                                                                |                       |
| 7.1                                                                                                                                                  | Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list. |                       |

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| 7.2                                                                                                                                                  | <p>Ample space for ease of operation and maintenance including equipment removal, tube bundle / cartridge / rotor pulling etc shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.</p> |                       |
| 7.3                                                                                                                                                  | <p>Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part. Suitable beams, hooks etc. for this purpose shall be provided in the Buildings.</p>                                                                                                                                                                                        |                       |
| 7.4                                                                                                                                                  | <p>Lifting devices like lifting tackles, slings etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.</p>                                                                                                                                                                                                                               |                       |
| 7.5                                                                                                                                                  | <p>All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where ever feasible, common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.</p>                                                                                    |                       |
| <b>8.0</b>                                                                                                                                           | <b><u>MATERIALS</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| 8.1                                                                                                                                                  | <p>In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/ fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.</p> <p>All materials shall be new, and shall be of the quality most suited to the proposed application.</p>   |                       |
| 8.2                                                                                                                                                  | <p>In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or International codes of practice. Where such standards or codes of practice are not available, sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application.</p>                               |                       |

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| <p>All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.</p> |                                                                                                                                                                                                                                                                                                                                                                 |                       |
| 8.3                                                                                                                                                    | <p>All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.</p>                                        |                       |
| <b>9.0</b>                                                                                                                                             | <b><u>LUBRICATION</u></b>                                                                                                                                                                                                                                                                                                                                       |                       |
| 9.1                                                                                                                                                    | <p>Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.</p>                                                                                                                                                                                                                              |                       |
| 9.2                                                                                                                                                    | <p>Non ferrous capillary tubing shall be used throughout.</p>                                                                                                                                                                                                                                                                                                   |                       |
| 9.3                                                                                                                                                    | <p>Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.</p>                                                                                                                                               |                       |
| 9.4                                                                                                                                                    | <p>All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.</p>                                                                                                                           |                       |
| 9.5                                                                                                                                                    | <p>All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.</p> |                       |
| 9.6                                                                                                                                                    | <p>The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.</p>                                                                                                                                                                                                                                                         |                       |
| <b>10.0</b>                                                                                                                                            | <b><u>LUBRICANTS AND CONTROL FLUIDS</u></b>                                                                                                                                                                                                                                                                                                                     |                       |
| 10.1                                                                                                                                                   | <p>The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of unit.</p>                                                                 |                       |

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| 10.2                                                                                                                                                 | <p>The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognized standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.</p> |                       |
| 10.3                                                                                                                                                 | <p>No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |
| <b>11.0</b>                                                                                                                                          | <b><u>OPERATION AND MAINTENANCE</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| 11.1                                                                                                                                                 | <p>The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimized.</p> <p>The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |
| 11.2                                                                                                                                                 | <p>Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                       |
| 11.3                                                                                                                                                 | <p>All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further, identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| 11.4                                                                                                                                                 | <p>All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                       |

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| REV: R0                                                                                                                                              | MASTER SPECIFICATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Page 76 of 555 |              |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |
| 11.5                                                                                                                                                 | On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |              |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |
| 11.6                                                                                                                                                 | All equipment and major valves should be provided with adequate maintenance approach and facility.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |              |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |
| 12.0                                                                                                                                                 | <b><u>PLANT LIFE AND MODE OF OPERATION</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |              |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |
|                                                                                                                                                      | <p>The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.</p> <p>The critical components of the major equipments like Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.</p> <p>The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand. The units shall also be suitable for two shift operation, if required.</p> <p>The expected start-ups should be considered as minimum<br/>(Based on HPT metal temperature)</p> <table><tr><td>(a)</td><td>Cold start-up ( &gt;50 hrs. shutdown)</td><td>:</td><td>20 per year</td></tr><tr><td>(b)</td><td>Warm start-up (between 10 to 50 hrs. of shutdown)</td><td>:</td><td>40 per year</td></tr><tr><td>(c)</td><td>Hot start-up (Less than 10 hrs. shutdown)</td><td>:</td><td>180 per year</td></tr></table> <p>The allowable stresses shall be so selected so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall</p> |                | (a)          | Cold start-up ( >50 hrs. shutdown) | : | 20 per year | (b) | Warm start-up (between 10 to 50 hrs. of shutdown) | : | 40 per year | (c) | Hot start-up (Less than 10 hrs. shutdown) | : | 180 per year |
| (a)                                                                                                                                                  | Cold start-up ( >50 hrs. shutdown)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | :              | 20 per year  |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |
| (b)                                                                                                                                                  | Warm start-up (between 10 to 50 hrs. of shutdown)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | :              | 40 per year  |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |
| (c)                                                                                                                                                  | Hot start-up (Less than 10 hrs. shutdown)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | :              | 180 per year |                                    |   |             |     |                                                   |   |             |     |                                           |   |              |

**CONSULTANT : PROCON ENGINEERS**



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| <br><b>MAHAGENCO</b><br>Maharashtra State Power Generation Co. Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: II            |
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| <b>REV: R0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>MASTER SPECIFICATIONS</b>                       | <b>Page 78 of 555</b> |
| <p>road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.</p> <p>The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition, the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.</p> <p>For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.</p> <p>Specification of Packaging and Marking has been described in detail in Volume I: General Condition of Contract of the Specification.</p> <p><b>14.0      <u>PROTECTION</u></b></p> <p>Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.</p> <p>Electrical equipment controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.</p> <p>All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded</p> |                                                    |                       |

**CONSULTANT : PROCON ENGINEERS**

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| <br><b>MAHAGENCO</b><br><small>Maharashtra State Power Generation Co. Ltd.</small>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: II            |
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| <b>REV: R0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>MASTER SPECIFICATIONS</b>                       | <b>Page 79 of 555</b> |
| <p>openings shall be closed with forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.</p> <p>Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.</p> <p><b>15.0      <u>PAINTING</u></b></p> <p><b>15.1      <u>GENERAL</u></b></p> <p>All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.</p> <p>All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.</p> <p>All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.</p> <p>All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.</p> <p>Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in</p> |                                                    |                       |

**CONSULTANT : PROCON ENGINEERS**

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| <b>REV: R0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MASTER SPECIFICATIONS</b>                       | <b>Page 80 of 555</b> |
| <p>windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.</p> <p>Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.</p> <p>Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.</p> <p>The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.</p> <p>The Contractor shall select shop primer for steel and iron surfaces, which will have a continuous operating temperature below 35°C, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.</p> <p>The Owner/Engineer shall submit the colour scheme during execution of contract for approval.</p> <p><b>15.2      <u>PREPARATION</u></b></p> <p>Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.</p> <p>Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.</p> <p>The priming coat shall be applied without delay.</p> <p><b>15.3      <u>DAMAGED PAINTWORK</u></b></p> <p>Any damaged paintwork shall be made good as follows:</p> |                                                    |                       |

**CONSULTANT : PROCON ENGINEERS**

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| <div>15.3.1      The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.</div> <div>15.3.2      A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.</div> <div>15.3.3      The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming</div> <div>15.4        <u><b>PAINTING SYSTEMS</b></u></div> <div>              The requirements for the Dry Film Thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.</div> <div>15.4.1      Surfaces subject to Weathering</div> <div>              All surfaces shall have a minimum of four coats of paint made up as follows:</div> <div>              (a)      Primer coat 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| <br><b>MAHAGENCO</b><br>Maharashtra State Power Generation Co. Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>MAHARASHTRA STATE POWER GENERATION CO. LTD.</b> | Volume: II     |
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| <b>REV: R0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>MASTER SPECIFICATIONS</b>                       | Page 82 of 555 |
| <p>The Contractor shall select the type and colour of primer &amp; finish coat after approval by the Owner.</p> <p>For detail painting on building &amp; structural steel elements, please refer <b>Volume VI / A &amp; B</b> of this specification.</p> <p><b>16.0      <u>COLOUR CO-ORDINATION &amp; FINISH</u></b></p> <p>16.1      Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.</p> <p>16.2      Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.</p> <p>16.3      All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.</p> <p>16.4      Final colours and finishes shall be to the Approval of the Engineer.</p> <p><b>17.0      <u>ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT</u></b></p> <p>17.1      <u>ENVIRONMENT PROTECTION</u></p> <p>The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and Stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.</p> <p>In case the Ministry of Environment &amp; Forest stipulates any other conditions not specified hereunder while clearing the project, same shall be complied with by the Contractor.</p> |                                                    |                |

**CONSULTANT : PROCON ENGINEERS**

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| <p>17.1.1 For Liquid Effluent</p> <p>(a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI: General Standards for discharge of Environmental pollutants Part-A: Effects of Environmental (Protection) Rules 1986, as amended till date.</p> <p>(b) Any specific requirement of State Pollution Authorities over and above the above stipulation</p> <p>17.1.2 For Air Emission</p> <p>(a) Suspended Particulate Matter i.e. dust burden at Chimney outlet - Maximum 50 mg/Nm<sup>3</sup> (with worst coal and one field out).</p> <p>(b) NO<sub>x</sub> : 365 ppm (maximum) or 750 mg/Nm<sup>3</sup> (Equivalent NO<sub>2</sub>).</p> <p>(c) SO<sub>2</sub> : As per prevailing Indian/ World Bank standards</p> <p>The Bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.</p> <p>17.2 <u>NOISE LEVEL REQUIREMENT</u></p> <p>The plant shall be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.</p> <p>17.2.1 Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 M away from the noise emission source.</p> <p>17.2.2 Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.</p> <p>17.2.3 Any statutory changes in stipulations regarding noise limitation that may occur in future according to Maharashtra Pollution Control Board or Central Pollution Control Board or Ministry of Environment &amp; Forest regulation</p> |                                                    |                |

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| <p>during tenure of the contract, the Contractor shall comply with the requirement.</p> <p>An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.</p> <p><b>18.0      <u>INSPECTION AND TESTING</u></b></p> <p><b>18.1      <u>GENERAL:</u></b></p> <p>18.1.1      An indicative list of Inspection and testing requirements for each package has been given for equipments across various volumes of this specification. Bidder shall note that these testing and inspections listed herein are the minimum requirements as perceived by the Owner; the bidder shall consider this only as a general guidance and is not meant to be exhaustive. The bidder shall consider requisite testing and inspections across the equipments / systems forming the proposed power plant unit based on his own experience and in line with the current industry practices for identically rated power plant for the technology under consideration. The comprehensive list of tests considered for each of the equipment/ systems shall be furnished as part of the bid.</p> <p><b>18.2      <u>INSPECTION AND TESTS DURING MANUFACTURE</u></b></p> <p>18.2.1      The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.</p> <p>18.2.2      The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this Specification.</p> <p>18.2.3      Before any item of plant or equipment leaves its place of manufacture, the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.</p> <p>18.2.4      Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in</p> |                                                    |                |

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| <p>writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.</p> <p>The Contractor shall forthwith forward to the engineer duly certified six (6) copies of the Test Certificates. Distribution of six (6) copies of Test Certificates for approval will be two (2) copies to Owner and four (4) copies to Consultant. These four (4) copies will be further distributed by Consultant after approval to Owner, site and bidder. One copy will be retained with the Consultant for record purpose.</p> <p>Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to Owner, Three (3) copies to site, Two (2) copies to Consultant, Two (2) copies to Owner's library / record.</p> <p>18.2.5 Under no circumstances any repair or welding of castings shall be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.</p> <p>18.2.6 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.</p> <p>Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.</p> <p>18.2.7 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Owner. The certificates shall include tests for mechanical properties and chemical analysis of representative material.</p> <p>18.2.8 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one</p> |                                                    |                       |

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| <p>hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.</p> <p>18.2.9 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.</p> <p>18.2.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR, as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination, magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.</p> <p>18.2.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR Maharashtra Jurisdiction) shall also be made by the Bidder. In such case, Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.</p> <p>18.3 <u><b>PERFORMANCE TESTS AT SITE</b></u></p> <p>18.3.1 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected system shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the system under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks etc.</p> <p>18.3.2 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.</p> <p>18.3.3 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection,</p> |                                                    |                |

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| <p>pre-commissioning to tests on completion and commissioning of the complete system/equipment.</p>                                                                                                                                                                                                                  |                                                                                                                    |                            |                            |
| 18.4                                                                                                                                                                                                                                                                                                                 | For details of specific tests required on individual equipment, refer to respective section of this specification. |                            |                            |
| <b>19.0</b>                                                                                                                                                                                                                                                                                                          | <b><u>TRAINING OF OWNER'S PERSONNEL</u></b>                                                                        |                            |                            |
| <p>The Contractor shall extend all possible assistance and co-operation to the Owner regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.</p>                                                                                            |                                                                                                                    |                            |                            |
| <p>Number of man-days of training as mentioned below shall be included in Tender.</p>                                                                                                                                                                                                                                |                                                                                                                    |                            |                            |
| <b>19.1</b>                                                                                                                                                                                                                                                                                                          | <b><u>TRAINING AT CONTRACTOR'S PREMISES</u></b>                                                                    |                            |                            |
| <p>The Contractor shall conduct training of Thirty (30) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contract.</p> |                                                                                                                    |                            |                            |
| <p>The total man-months for training of engineers shall be maximum Thirty (30), having following indicative break-up:</p>                                                                                                                                                                                            |                                                                                                                    |                            |                            |
|                                                                                                                                                                                                                                                                                                                      | <b>Discipline</b>                                                                                                  | <b>Number of Engineers</b> | <b>Number of Man-month</b> |
| (a)                                                                                                                                                                                                                                                                                                                  | Operation                                                                                                          | 10 heads                   | 10                         |
| (b)                                                                                                                                                                                                                                                                                                                  | Maintenance<br>(Boiler & Turbine)                                                                                  | 10 heads                   | 10                         |
| (c)                                                                                                                                                                                                                                                                                                                  | Electrical Maintenance                                                                                             | 4 heads                    | 4                          |
| (d)                                                                                                                                                                                                                                                                                                                  | Control & Instrumentation                                                                                          | 4 heads                    | 4                          |
| (e)                                                                                                                                                                                                                                                                                                                  | Maintenance Planning                                                                                               | 2 heads                    | 2                          |
|                                                                                                                                                                                                                                                                                                                      |                                                                                                                    | 30 heads                   | 30                         |

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However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Owner.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule, which shall be submitted to the Owner for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Owner upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Owner's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to:

- (a) Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

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| <p>(b) Plant operation and systems training for operators including simulator training as applicable.</p> <p>(c) Maintenance training programme covering electrical, mechanical and instrumentation and control.</p> <p>Said training programme shall be submitted to the Owner for approval.</p> <p>The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.</p> <p>The Contractor shall provide qualified English speaking instructors and training coordinator (s) during the tenure of the training programme.</p> <p><b>19.2 <u>OPERATION AND MAINTENANCE TRAINING AT SITE</u></b></p> <p>The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the Unit.</p> <p>The following instructors shall be at the Site continuously during the training:</p> <p>(a) One (1) for Steam Generator and Auxiliaries ;</p> <p>(b) One (1) for Turbine Generator and Auxiliaries ;</p> <p>(c) One (1) for Electrical Works ;</p> <p>(d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;</p> <p>(e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).</p> <p>Instructors shall also be available for Coal handling Plant, Ash Handling Plant, Water Treatment Plant and other specific areas as per requirement.</p> |                                                    |                       |

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| <p>19.3      <u>ON-THE-JOB TRAINING</u></p> <p>During the period of pre-commissioning, commissioning and trial operation, the Owner shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.</p> <p>The Owner shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.</p> |                                                    |                |

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### **LIST OF STANDARDS FOR REFERENCE**

#### **ANNEXURE – A**

- 1.0 International Standards Organisation (ISO)
- 2.0 International Electro-technical Commission (IEC)
- 3.0 American Society of Mechanical Engineers (ASME)
- 4.0 American National Standards Institute (ANSI)
- 5.0 American Society for Testing and Materials (ASTM)
- 6.0 American Institute of Steel Construction (AISC)
- 7.0 American Welding Society (AWS)
- 8.0 Architecture Institute of Japan (AIJ)
- 9.0 National Fire Protection Association (NFPA)
- 10.0 National Electrical Manufacturer's Association (NEMA)
- 11.0 Japanese Electro-technical Committee (JEC)
- 12.0 Institute of Electrical and Electronics Engineers (IEEE)
- 13.0 Federal Occupational Safety and Health Regulations (OSHA)
- 14.0 Instrument Society of America (ISA)
- 15.0 National Electric Code (NEC)
- 16.0 Heat Exchanger Institute (HEI)
- 17.0 Tubular Exchanger Manufacturer's Association (TEMA)

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| 18.0                                                                                                                                                                | Hydraulic Institute (HIS)                                             |                       |
| 19.0                                                                                                                                                                | International Electro-Technical Commission (IEC) Publications         |                       |
| 20.0                                                                                                                                                                | Power Test Code for Steam Turbines (PTC)                              |                       |
| 21.0                                                                                                                                                                | Applicable German Standards (DIN)                                     |                       |
| 22.0                                                                                                                                                                | Applicable British Standards (BS)                                     |                       |
| 23.0                                                                                                                                                                | Applicable Japanese Standards (JIS)                                   |                       |
| 24.0                                                                                                                                                                | Electric Power Research Institute (EPRI)                              |                       |
| 25.0                                                                                                                                                                | Standards of Manufacturer's Standardization Society (MSS)             |                       |
| 26.0                                                                                                                                                                | Bureau of Indian Standards (BIS)                                      |                       |
| 27.0                                                                                                                                                                | Indian Electricity Rules                                              |                       |
| 28.0                                                                                                                                                                | Indian Boiler Regulations (IBR)                                       |                       |
| 29.0                                                                                                                                                                | Indian Explosives Act                                                 |                       |
| 30.0                                                                                                                                                                | Indian Factories Act                                                  |                       |
| 31.0                                                                                                                                                                | Tariff Advisory Committee (TAC) rules                                 |                       |
| 32.0                                                                                                                                                                | Emission regulation of Central Pollution Control Board (CPCB)         |                       |
| 33.0                                                                                                                                                                | Pollution Control regulations of Dept. of Environment, Govt. of India |                       |
| 34.0                                                                                                                                                                | Central Board of Irrigation and Power (CBIP) Publications             |                       |
| 35.0                                                                                                                                                                | The Air Prevention and Control of Pollution Act                       |                       |
| 36.0                                                                                                                                                                | The Environmental Protection Act                                      |                       |
| 37.0                                                                                                                                                                | The Public Liability Insurance Act                                    |                       |

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| <p>38.0      The Forest Conservation Act</p> <p>39.0      The Wildlife protection Act</p> <p>40.0      The EIA Notification, 1994</p> <p>41.0      IS: 14665-Specification for Electric Traction Lift</p> <p>42.0      Any other statutory Codes/Standards/Regulation</p> |                                                    |                |

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| <div><b><u>CRITERIA FOR LAYOUT</u></b></div> <div><b><u>ANNEXURE – B</u></b></div>                                                                   |                                                                                                                                                                          |                                               |                |
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| 1.0                                                                                                                                                  | <b><u>SITE CONDITIONS TO BE CONSIDERED</u></b>                                                                                                                           |                                               |                |
| 1.1                                                                                                                                                  | Prevalent wind direction during summer (for deciding cooling tower orientation)                                                                                          | See wind-rose in plot plan.                   |                |
| 1.2                                                                                                                                                  | Prevalent wind direction (s) during dry seasons (for deciding the location of coal stock pile and ash dump/unloading areas, minimising the pollution effect due to dust) | See wind-rose in plot plan.                   |                |
| 1.3                                                                                                                                                  | Location of                                                                                                                                                              |                                               |                |
| 1.3.1                                                                                                                                                | Raw Water intake point                                                                                                                                                   | As shown in Plot Plan                         |                |
| 1.3.2                                                                                                                                                | Plant drainage outfall point (s)                                                                                                                                         | In Existing Drainage/Effluent treatment Plant |                |
| 1.3.3                                                                                                                                                | Railway entries & exits                                                                                                                                                  | As shown in Plot Plan                         |                |
| 1.3.4                                                                                                                                                | Road entries & exits                                                                                                                                                     | As shown in Plot Plan                         |                |
| 1.3.5                                                                                                                                                | Electrical power transmission grid system                                                                                                                                | As shown in Plot Plan                         |                |
| 1.3.6                                                                                                                                                | Preferred / selected ash dump area                                                                                                                                       | Velhala nearly 10 Km from the site            |                |
| 1.3.7                                                                                                                                                | Nearest residential area                                                                                                                                                 | Existing Colony                               |                |

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| <b>2.0</b>                                                                                                                                           | <b><u>LAYOUT REQUIREMENTS</u></b>                  |                                                                                                                                                                                                                        |                |
| 2.1                                                                                                                                                  | <u>MAXIMUM PERMISSIBLE SLOPE IN</u>                |                                                                                                                                                                                                                        |                |
| 2.1.1                                                                                                                                                | Rail track                                         | 1 in 400                                                                                                                                                                                                               |                |
| 2.1.2                                                                                                                                                | Road                                               | 1 in 30                                                                                                                                                                                                                |                |
| 2.1.3                                                                                                                                                | Sides of unpaved embankment                        | 1 in 2                                                                                                                                                                                                                 |                |
| 2.2                                                                                                                                                  | <u>REQUIRED ROAD WIDTH</u>                         |                                                                                                                                                                                                                        |                |
| 2.2.1                                                                                                                                                | Main roads                                         | 14.00 Metres with 1.0 m wide shoulders on either side for outer roads on western and eastern side and 7 meters with 1.5 m wide shoulders for other two sides of power block.                                           |                |
| 2.2.2                                                                                                                                                | Auxiliary interconnections                         | Minimum 4 Metres without shoulders on either side and shall vary upto 7 m subject to availability of space.<br><br>For carriage way, 5 Metre wide with 0.5 Metre shoulders and 7.0 Mtre wide with 1.5 Metre shoulders. |                |
| 2.2.3                                                                                                                                                | Road to the power house unloading bay              |                                                                                                                                                                                                                        |                |
| (a)                                                                                                                                                  | Only for entry to the unloading bay                | Yes                                                                                                                                                                                                                    |                |
| (b)                                                                                                                                                  | To pass through the unloading bay                  | No                                                                                                                                                                                                                     |                |
|                                                                                                                                                      |                                                    |                                                                                                                                                                                                                        |                |

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| 2.3                                                                                                                                                  | Required minimum horizontal distance between the nearest points of                                                   |                                                                                 |                |
| 2.3.1                                                                                                                                                | Plant boundary and the boundary of residential area                                                                  | (Local municipality/factory rule)                                               |                |
| 2.3.2                                                                                                                                                | Electrical transformer and any other                                                                                 | As per the Tariff Advisory Committee Rules                                      |                |
| 2.3.3                                                                                                                                                | Fire water supply installation and any building / facility subject to fire risk.                                     | As per the Tariff Advisory Committee Rules                                      |                |
| 2.3.4                                                                                                                                                | Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities | Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code |                |
| 2.4                                                                                                                                                  | Required minimum vertical clearance                                                                                  |                                                                                 |                |
| 2.4.1                                                                                                                                                | Under pipes/cable racks at road crossings                                                                            | 8.0 Metres                                                                      |                |
| 2.4.2                                                                                                                                                | Soil coverage over underground pipes                                                                                 | 1.0 Metre (minimum)                                                             |                |
| 2.4.3                                                                                                                                                | Pipe/Cable trench                                                                                                    | Not Acceptable                                                                  |                |
| 2.5                                                                                                                                                  | Railway Wagon clearance                                                                                              | Rules of the Indian Railways                                                    |                |
| 2.6                                                                                                                                                  | Minimum Clearance between any road edge and building/ structure / any fixed installation                             | 3 Metres                                                                        |                |
| 2.7                                                                                                                                                  | Required level, above the local developed grade level, of                                                            |                                                                                 |                |

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| 2.7.1                                                                                                                                                | Top of all roads                                                                                   | 150 mm                                                   |                |
| 2.7.2                                                                                                                                                | All outdoor paved areas                                                                            | 150 mm                                                   |                |
| 2.8                                                                                                                                                  | Temporary storage areas, workshops, offices, residence etc. required at the time of erection work. | Yes                                                      |                |
| 2.9                                                                                                                                                  | Green belt around power plant area                                                                 | As per environmental guidelines of MOEF, Govt. of India. |                |
|                                                                                                                                                      |                                                                                                    |                                                          |                |

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| <p align="center"><b><u>BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS</u></b></p> <p align="center"><b><u>ANNEXURE – C</u></b></p>                         |                                                                                                                                                                                                          |                                         |
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| <b>1.0</b>                                                                                                                                           | Minimum clear space required at all working and walking areas for operating & maintenance personnel                                                                                                      |                                         |
| <b>1.1</b>                                                                                                                                           | <u>HORIZONTAL, IN ALL DIRECTIONS</u>                                                                                                                                                                     |                                         |
| 1.1.1                                                                                                                                                | Adjacent to any electrical equipment, electrical cables, running (rotating / reciprocating) equipment, safety valve or vent / drain pipe outlet, pipe / equipment of surface temperature exceeding 60°C. | 1200 mm                                 |
| 1.1.2                                                                                                                                                | Adjacent to any other plant facilities (including walls / structures)                                                                                                                                    | 1000 mm                                 |
| <b>1.2</b>                                                                                                                                           | <u>VERTICAL</u> (head-room clearance)                                                                                                                                                                    |                                         |
| 1.2.1                                                                                                                                                | Under any pipe / equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.                                                                                    | 2.0 Metre                               |
| 1.2.2                                                                                                                                                | Under any other plant facilities (including structures, pipes etc.)                                                                                                                                      | 2.0 Metre                               |
|                                                                                                                                                      |                                                                                                                                                                                                          |                                         |

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| 1.3                                                                                                                                                  | For all areas where any equipment (including trucks, trolleys and other material handling equipment) move or manoeuvre.                                                                                                                      | Minimum 500 mm clear in all direction from the outer edges of the equipment                                                           |                 |
| 1.4                                                                                                                                                  | Minimum clear hand space required for                                                                                                                                                                                                        |                                                                                                                                       |                 |
| 1.4.1                                                                                                                                                | The application of thermal insulation                                                                                                                                                                                                        | 100 mm                                                                                                                                |                 |
| 1.4.2                                                                                                                                                | Welding work                                                                                                                                                                                                                                 | 150 mm                                                                                                                                |                 |
| 1.4.3                                                                                                                                                | Bolt tightening                                                                                                                                                                                                                              | 150 mm                                                                                                                                |                 |
| 2.0                                                                                                                                                  | <b><u>FLOORS, PLATFORMS, STAIRCASE, LADDERS, WALLS, DOORS &amp; WINDOWS</u></b>                                                                                                                                                              |                                                                                                                                       |                 |
| 2.1                                                                                                                                                  | Statutory Requirement                                                                                                                                                                                                                        | As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc. |                 |
| 2.2                                                                                                                                                  | <b><u>OPERATION &amp; MAINTENANCE REQUIREMENT</u></b>                                                                                                                                                                                        |                                                                                                                                       |                 |
| 2.2.1                                                                                                                                                | Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ Maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required. | Yes                                                                                                                                   |                 |
|                                                                                                                                                      |                                                                                                                                                                                                                                              |                                                                                                                                       |                 |

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| 2.2.2                                                                                                                                                | Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.                                                                                                                 | Yes                                                                                                                       |
| 2.3                                                                                                                                                  | Minimum access opening required (with rolling shutter) transportation,                                                                                                                                                                                                                                                                                   | 3.5 M wide x 4 M high or wherever entry of truck, for material depending upon the envisaged equipment size to be handled. |
| 2.4                                                                                                                                                  | Plinth level of all buildings, above the local developed for power house building.                                                                                                                                                                                                                                                                       | 300 mm                                                                                                                    |
| <b>3.0</b>                                                                                                                                           | <b><u>OTHER MAINTENANCE REQUIREMENT</u></b>                                                                                                                                                                                                                                                                                                              |                                                                                                                           |
| 3.1                                                                                                                                                  | Generator stator handling<br><br>In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking / lowering assembly, dismantling of building end walls / structures etc. shall be kept. | Yes                                                                                                                       |
|                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                           |

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| 3.2                                                                                                                                                  | Maintenance of the internals / impellers of all important equipment, like Boiler Feed Pumps, Feed Water Heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, Cooling Water Pumps, Coal Mills, Air Compressors, Blowers, Heat Exchangers, Fuel Oil Pumps, Filters etc. | Shall be possible without disconnecting or dismantling any piping/ducting.                              |                 |
| 3.3                                                                                                                                                  | Overhauling and handling of the casings for the above items                                                                                                                                                                                                                                                      | Shall be possible without disturbing / dismantling any piping / ducting not directly connected to them. |                 |
| 3.4                                                                                                                                                  | Crane Approach<br><br>Wherever required, the unobstructed approach of the crane hook / other hoisting equipment hook to various plant & equipment shall be possible.                                                                                                                                             | Yes                                                                                                     |                 |
| 4.0                                                                                                                                                  | <b><u>CENTRAL CONTROL ROOM</u></b><br><br>All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.                                                             | Yes                                                                                                     |                 |
|                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                  |                                                                                                         |                 |

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| 5.0                                                                                                                                                  | The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. |                                  |                 |
| 5.1                                                                                                                                                  | However, as a guide line, following features are given:                                                                                                                                                                                            |                                  |                 |
| 5.1.1                                                                                                                                                | False ceiling and false flooring shall be provided.                                                                                                                                                                                                |                                  |                 |
| 5.1.2                                                                                                                                                | Uniform height, colouring schemes for cabinets etc. shall be available.                                                                                                                                                                            |                                  |                 |
| 5.1.3                                                                                                                                                | The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.                                                                                                                           |                                  |                 |
| 5.1.4                                                                                                                                                | No opening shall be provided from Boiler side.                                                                                                                                                                                                     |                                  |                 |
| 5.1.5                                                                                                                                                | Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.                                                                                                                    |                                  |                 |
| 5.1.6                                                                                                                                                | Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.                                                                                                                                                  |                                  |                 |
|                                                                                                                                                      |                                                                                                                                                                                                                                                    |                                  |                 |

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| 5.1.7                                                                                                                                                | The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX. |                                                                                              |                 |
| 5.1.8                                                                                                                                                | Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.                              |                                                                                              |                 |
| 5.1.9                                                                                                                                                | Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.                              |                                                                                              |                 |
| 6.0                                                                                                                                                  | Toilet and drinking water facility                                                                                                            | Required in all buildings and on all floors wherever operating personnel are to be deployed. |                 |
|                                                                                                                                                      |                                                                                                                                               |                                                                                              |                 |

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| <p style="text-align: center;"><b><u>SPECIFIC LAYOUT CONSIDERATIONS</u></b></p> <p style="text-align: center;"><b><u>ANNEXURE-D</u></b></p> <p>While developing the layouts, the following major layout parameters shall be ensured, as a minimum:</p> |                                                                    |                                                                    |
| <b><u>SR.NO.</u></b>                                                                                                                                                                                                                                   | <b><u>PARAMETER</u></b>                                            | <b><u>REQUIREMENTS</u></b>                                         |
| 1.0                                                                                                                                                                                                                                                    | AB bay, BC & CD bay widths                                         | 36.0 M, 12.0 M & 12.0M                                             |
| 2.0                                                                                                                                                                                                                                                    | Arrangement of TG set                                              | Longitudinal                                                       |
| 3.0                                                                                                                                                                                                                                                    | Floor levels in AB bay                                             | 0.0 M, 9.0 M, 17.0 M                                               |
| 4.0                                                                                                                                                                                                                                                    | Floor levels in B-C bay                                            | 0.0 M, 9.0 M, 17.0 M<br>24.0M, 28.0 M<br>32.8 M, 38.0 M            |
| 5.0                                                                                                                                                                                                                                                    | Level of operating floor                                           | 17.0 M                                                             |
| 6.0                                                                                                                                                                                                                                                    | Level of mezzanine floor                                           | 9.0 M                                                              |
| 7.0                                                                                                                                                                                                                                                    | HT/LT Switchgear and MCC location                                  | HT Switchgear at 3.5 M and LT Switchgear & MCC at 12.0 M in AB bay |
| 8.0                                                                                                                                                                                                                                                    | Area of unloading bays                                             | 750 sq. M                                                          |
| 9.0                                                                                                                                                                                                                                                    | Lay down Area (Minimum on operating floor) with EOT Crane approach | 750 sq. M.                                                         |
| 10.0                                                                                                                                                                                                                                                   | Minimum clear working space around the equipment                   | 1200 mm                                                            |
| 11.0                                                                                                                                                                                                                                                   | Location of Deaerator                                              | In BC bay at EL. 38.0 M                                            |
|                                                                                                                                                                                                                                                        |                                                                    |                                                                    |

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| 12.0                                                                                                                                                 | Location of Heaters                                                                        | HP Heaters/LP Heaters at Operating Floor/ Mezzanine Floor respectively in B-C Bay. |                 |
| 13.0                                                                                                                                                 | Location of BFP                                                                            | TDBFP at Operating Floor and MDBFP at Ground Floor in AB Bay.                      |                 |
| 14.0                                                                                                                                                 | Location of Boiler MCC                                                                     | At 28.0 M in BC bay                                                                |                 |
| 15.0                                                                                                                                                 | Clear Head room within Main plant Building for pipes, structures & cable trays, ducts etc. | 2.5 M                                                                              |                 |
| 16.0                                                                                                                                                 | Number of Fire Escape staircases in the main plant with fire doors at each landing         | Minimum Four (4)                                                                   |                 |
| 17.0                                                                                                                                                 | Minimum width of all staircases landings                                                   | 1500 mm                                                                            |                 |
| 18.0                                                                                                                                                 | Passenger Elevators                                                                        | One (min)                                                                          |                 |
| 19.0                                                                                                                                                 | Clear approach width in front and rear of ESP                                              | 10 M (Height = 8 M)                                                                |                 |
| 20.0                                                                                                                                                 | Head Room for pipe/cables trestles at rail, road crossing                                  | 8.0 M                                                                              |                 |
| 21.0                                                                                                                                                 | Minimum straight length in Flue gas duct at ESP outlet for Opacity meters.                 | As required for accurate dust measurement within the battery limits.               |                 |
| 22.0                                                                                                                                                 | Elevation of ID Ducts entering Chimney                                                     | 12.75 M (Min.) (Bottom of steel)                                                   |                 |
|                                                                                                                                                      |                                                                                            |                                                                                    |                 |

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| <div style="text-align: center; padding: 100px 0;"> <p><b>VOLUME III-F</b></p> <p><b>SECTION-1</b></p> <p><b>POWER CYCLE PIPING, VALVES AND SPECIALTIES</b></p> </div> |                                                    |               |

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| <div data-bbox="204 409 620 445" data-label="Section-Header"> <h2>1.0 <u>INTRODUCTION</u></h2> </div> <div data-bbox="346 486 1412 600" data-label="Text"> <p>This section covers all the piping, valves and specialties which connect the different equipment like the boiler, turbine, condenser, pumps, heaters etc. to make the power cycle complete.</p> </div> <div data-bbox="204 638 857 674" data-label="Section-Header"> <h2>2.0 <u>PERFORMANCE REQUIREMENT</u></h2> </div> <div data-bbox="346 712 1414 943" data-label="Text"> <p>The piping system acts as the pressure boundary for the fluid in circulation, water and steam in this case, which is subject to high pressure, temperature, change of phase and various types of transient and steady state operation. All the piping systems supplied shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years and shall withstand to the maximum sustained load.</p> </div> <div data-bbox="204 981 718 1019" data-label="Section-Header"> <h2>3.0 <u>CODES &amp; STANDARDS</u></h2> </div> <div data-bbox="204 1059 1414 1171" data-label="Text"> <p>3.1 The design, manufacture, inspection and testing of the equipment covered under this specification shall conform, in general, to the standards and codes mentioned below:</p> </div> <div data-bbox="204 1211 1410 1680" data-label="List-Group"> <ul style="list-style-type: none"> <li>3.1.1 ANSI B-31.1 : Code for Pressure Piping - "Power Piping".</li> <li>3.1.2 Indian Boiler Regulations : (IBR), with latest amendment.</li> <li>3.1.3 ANSI B-16.5 : "Steel pipe flanges and flanged fittings".</li> <li>3.1.4 ANSI B-16.9 : Wrought steel Butt weld fittings.</li> <li>3.1.5 ANSI B-16.11 : "Socket Weld Fittings".</li> <li>3.1.6 ANSI B-16.25 : "Butt Welding Ends".</li> <li>3.1.7 ANSI B-16.34 : "Steel Valves - Flanged and Butt Welding Ends".</li> </ul> </div> <div data-bbox="204 1720 1415 1877" data-label="Text"> <p>3.2 Design, fabrication, assembly and testing of pipes, fittings shall generally conform to the requirements of ANSI B-31.1. But the portions, which come under the purview of Indian Boiler Regulations (IBR), shall completely comply the requirements of IBR, as a minimum.</p> </div> |                                                     |                |

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| <b>CONSULTANT : PROCON ENGINEERS</b> |
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| <p>Any other internationally accepted codes and standards are also acceptable. However, the compliance of ANSI codes and IBR will be considered as minimum for acceptance of the piping and all appurtenances.</p> <p><b>4.0      <u>SCOPE OF WORK</u></b></p> <p><b>4.1      <u>SCOPE OF SUPPLY</u></b></p> <p>Scope shall include all piping, valves &amp; specialties as indicated in Annexure-I.</p> <p><b>4.1.1</b>      In general, the equipment and materials to be supplied under this specification shall include, as a minimum:</p> <ul style="list-style-type: none"> <li>(a)      Supply of all power cycle piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc as required.</li> <li>(b)      Matching pipes, matching pieces like reducers/enlargers etc, counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.</li> <li>(c)      The pipe spools shall be supplied along with necessary test certificates of the pipes, after necessary machining to the required bore, for assembly of flow nozzle element. The assembled flow nozzle shall be installed in the piping system. Additional length of pipes equal to length of all fully assembled flow nozzle &amp; orifice plates pipe piece shall be supplied and the same shall also be erected prior to cleaning of the pipes by flushing or steam blowing or chemical cleaning or both. After completion of cleaning of piping, the assembled flow nozzles shall be erected replacing the temporary pipe spools.</li> <li>(d)      All motorised valves, manually operated isolating and regulating valves, non- return valves, steam traps, relief/safety valves, strainers, pressure reducing orifices, expansion joints and other flexible connections, complete with the counter flanges and matching connecting pieces as required within the entire power cycle piping system.</li> </ul> |                                                     |                |

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| <p>(e) Anchors, hangers and supports, vibration dampeners, restraints, shock absorbers etc as required.</p> <p>(f) Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor including access ladders, supporting structures etc.</p> <p>(g) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel including pipe supports in trenches.</p> <p>(h) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated either in Blowdown tank/flash tanks or permanent drain trenches of the Power Station. All steam and saturated water open drains shall be drained through a water seal in drain funnels/tundish with a water connection in funnels/tundish for maintaining water seal level in them. All oily effluent drains shall be separately routed and connected to separate pit.</p> <p>(i) For the isolation and check valves located on the main steam, hot reheat, cold reheat, L.P. bypass and extraction lines, suitable line drains shall be provided just upstream and downstream of each of these valves. No drain is needed at the downstream of L.P. bypass isolation valve. Each of these drains shall be independently led to the condenser with branching off to atmosphere.</p> <p>Line drains from Main Steam, Hot Reheat, Cold Reheat, L.P. bypass &amp; high pressure (above 40 kg/cm<sup>2</sup>) extraction lines shall be provided with double isolation valves in series for each branch - each located at the two extreme ties of the line drain route. The valve near the condenser shall be motorised one. The balance line drains shall be provided with only one isolation valve for each branch.</p> <p>(j) Bolts, nuts, washers, temporary and permanent gaskets, fasteners as required for interconnecting piping, valves &amp; fittings.</p> |                                             |                |

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| <p>(k) Complete insulation material for piping, valves, specialties &amp; auxiliary equipment specified in this specification and as called for in the specification for thermal insulation.</p> <p>(l) Painting of all piping, valves &amp; specialties at site. Coating and wrapping for buried pipes.</p> <p>4.1.2 Bidder shall furnish his own technical details of piping, valves, specialties and accessories along with his offer.</p> <p>Following general requirements shall however be considered:</p> <p>(a) Instrument Connections</p> <p>(b) Pipe stubs and blanking plates required for chemical cleaning and hydro testing.</p> <p>(c) Flanges, spool pieces, gaskets, ring joints, jointing materials, aluminium and stainless steel forged marking plate and temporary piping for steam blowing.</p> <p>(d) Drain/drip pockets on steam piping as per stipulation of ASME TDP – Volume I and general requirement.</p> <p>(e) Expansion marker for high temperature steam lines.</p> <p>(f) Fine threaded Radiography holes with stubs and suitable matching plugs which shall be finally seal welded for piping, more than 25 mm nominal thickness.</p> <p>For conducting performance test of Turbo-Generator and Boiler, the required pressure, temperature, flow measurement points shall be provided.</p> <p>(g) Provision for creep measurement on the piping operating in creep region.</p> <p>4.1.3 Electrodes and filler wires required for stainless steel and alloy steel welding during shop fabrication at works and erection/installation at site.</p> |                                             |                |

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| 4.1.4                                                                                                                                                | All temporary pipes and accessories, supporting arrangement for cleaning, flushing and steam blowing of the main steam, cold reheat and hot reheat piping including HP/LP by pass piping and auxiliary steam piping.                                                                                                                                                                                                                                |                |
| 4.2                                                                                                                                                  | <u>SCOPE OF SERVICES</u>                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| 4.2.1                                                                                                                                                | The Contractor shall design the piping system and perform necessary stress analysis of all piping and dynamic analysis as necessary for the piping systems shown in Annexure-I of Section - I.                                                                                                                                                                                                                                                      |                |
| 4.2.2                                                                                                                                                | For stress analysis purpose, individual piping systems shall be considered up to the anchor points (location to be decided during detail engineering). All anchors coming within the piping are to be designed, supplied and erected by the Contractor.                                                                                                                                                                                             |                |
| 4.2.3                                                                                                                                                | Stress analysis and hanger selection for all piping specified else where, including piping attachment for hangers/supports, all auxiliary supporting structures are included in the scope of the Contractor.                                                                                                                                                                                                                                        |                |
| 4.2.4                                                                                                                                                | The Contractor shall submit the design calculations for pipe sizing, thickness with specified diameters of pipes and stress analysis data to Owner/Engineer for review/ reference/records. Pressure drop calculation for main steam, cold reheat and hot reheat piping shall be submitted by the Contractor to show the adequacy of pipe sizes to meet steam parameter at turbine inlet.                                                            |                |
| 4.2.5                                                                                                                                                | Preparation of detailed fabrication drawings (isometric) of shop fabricated piping which are of size 50 NB and above should be based on the "Released for Construction" drawings pertaining to power cycle piping layout prepared by the Contractor.<br><br>"As built" drawings of the power cycle piping layout shall also be prepared by the Contractor based on any layout modifications made at site over "Released for Construction Drawings". |                |
| 4.2.6                                                                                                                                                | The Contractor shall design and detail all piping supports including restraints, guides, stops, snubbers, dampers etc based on the final stress analysis and hanger load data. The Contractor's design of all supports shall be submitted to the Owner/Engineer for review.                                                                                                                                                                         |                |

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| <p>4.2.7 The Contractor shall furnish separate sketches for each support, restraint, anchor, snubber, dampers, spring hangers etc. These sketches shall include the location with reference to column co-ordinates, identification number, bill of material, design loads, operating load, spring stiffness, amount of spring pre-compression etc and method of attachment to the pipe and steel structure.</p> <p>4.2.8 In order to ensure that all piping, supporting elements, anchors and restraints have been installed and adjusted in accordance with the drawings and other written instructions of the Contractor, the hangers associated with the main steam, hot reheat, cold reheat, HP &amp; LP by-pass, feed water, auxiliary steam piping etc. shall be inspected as follows :</p> <p>(a) After hydro test, with the piping in the cold position, with all travel stops removed, with the pipe completely insulated and in all respects ready for start-up.</p> <p>(b) Piping in the hot position, with the unit operating at maximum load.</p> <p>(c) Piping in the hot position after 6 months of operation.</p> <p>(d) Piping in the cold position during first complete shutdown after at least 6 months of operation.</p> <p>The contractor shall depute his personnel for this purpose to site if the plant is officially handed over to the owner before such inspection after 6 months of operation.</p> <p>4.2.9 At the time of each inspection, the Contractor shall determine the necessity for revision, adjustment or replacement of pipe supporting elements, restraints and anchors. Any changes proposed shall be incorporated by the Contractor after Owner's/Engineer's concurrence.</p> <p>4.2.10 All shop tests satisfying the requirements of Indian Boiler Regulations (IBR), ANSI standards, the standards enumerated herein and/or as specified.</p> <p>4.2.11 Furnishing drawings, data, design calculations, stress analysis results.</p> |                                                    |                |

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| <p>4.2.12      Furnishing certified copies of test results for all tests and examinations specified in the specification and for the mandatory tests and analysis required by the ASTM material specification, for the materials used for piping and the pressure parts of the valves.</p> <p>4.2.13      Obtaining approval from Chief Inspector of Boilers as per Indian Boiler Act, including the following:</p> <p style="padding-left: 40px;">(a)      For all pipelines coming under the purview of Indian Boiler Regulations (IBR), necessary approval of the design and layout drawings shall be obtained from the Chief Inspector of Boilers and furnished to the Owner/Engineer. Necessary certificates of design, manufacture and tests in specified Form of IBR, for each fabricated pipe with proper identification shall be submitted.</p> <p style="padding-left: 40px;">(b)      For fittings and specialties, viz. valves, flanges, traps and other specialties etc of all pipelines coming under the purview of IBR, Certificate of design, manufacture and tests in specified Form of IBR with appropriate identification shall be furnished to the Owner/Engineer.</p> <p style="padding-left: 40px;">(c)      Erection &amp; testing of the pipe lines coming under the purview of IBR shall meet all the requirements of IBR and certificate of manufacture &amp; tests in specified Form of IBR, for each of the erected pipe lines shall be submitted to the Owner/Engineer prior to the application of insulation and/or flushing the line before commissioning.</p> <p>4.2.14      Steam blowing or chemical cleaning of piping systems, as specified.</p> <p>4.2.15      Omission of specific reference to any item or material or work which is necessary for completion of the piping systems shall not relieve the bidder of the responsibility of furnishing all material and services for a complete installation satisfying the operational and other requirements stated in the specifications.</p> <p>4.2.16      Drawing indicating the layout of pipe work shall be prepared in line with the flow diagrams and shall be provided as part of the Contract. These drawings shall indicate the position of all supports, guides, restraints and anchors; all drain and vent connections and the position of all pipes. All</p> |                                                    |                |

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| <p>             piping systems shall be arranged to allow adequate falls in the direction of flow, except where otherwise approved by the Engineer. At the points of drainage, drain pockets of ample size and approved construction shall be fitted as per details indicated in the enclosed drawings.           </p> <p> <b>5.0 <u>SPECIFIC DESIGN CRITERIA</u></b> </p> <p> <b>5.1</b> Design, fabrication, testing &amp; erection of Power Cycle Piping, valves &amp; specialties for critical piping system under purview of IBR - To satisfy IBR, ANSI/ASME B31.1 code.           </p> <p>             Design, fabrication, testing &amp; erection of Power cycle piping, valves &amp; specialties for non-critical piping system, which are not under purview of IBR, to satisfy ANSI/ASME B31.1 code.           </p> <p>             Design of safety valve installation shall be conformed to the Non-mandatory rules for the design of safety valve installation of ANSI/ASME B31.1. Open discharge installation will be preferred.           </p> <p>             Metallic Expansion Bellow - As per EJMA           </p> <p> <b>5.2 <u>PIPING FLEXIBILITY ANALYSIS</u></b> </p> <p> <b>5.2.1</b> Piping to be analysed for pipe having sizes equal to or above 50 NB &amp; design temperature 100°C and more.           </p> <p> <b>5.2.2</b> ANSI/ASME B31.1 code shall be followed.           </p> <p> <b>5.2.3</b> Loading conditions to be considered combination of stresses, allowable stress values etc. shall be furnished by bidder for review.           </p> <p> <b>5.2.4</b> The results of stress analysis shall be submitted for approval by Engineer before start of Fabrication or Erection clearly confirming the following :           </p> <ul style="list-style-type: none"> <li>(a) The terminal forces, movements and moments are within permissible limit.</li> <li>(b) Forces and moments on supports, anchors and restraints attached to building/supporting structures are within permissible limit.</li> </ul> |                                                    |                |

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| <p>(c) Stresses on piping are within acceptable limit stipulated in the applicable codes.</p> <p>(d) Pipe movements are acceptable for the spacing in between adjacent pipes and between pipes and adjacent structures/equipment etc.</p> <p>(e) Stress checking for occasional loading.</p> <p>(f) All other stress/flexibility checking as stipulated in IBR/American codes whichever is stringent.</p> <p>Above stress analysis results shall be used for checking the piping design.</p> <p>5.2.5 The finalised flexibility analysis in the form of a report indicating procedure of analysis, pipe sizing based on specified diameter, spring hanger summary, design load charts for Anchors shall be prepared. Restraints and hanger supporting structures delineating different loading conditions, stress charts, loading on terminal anchors, along with isometric drawings of piping for flexibility analysis shall be submitted to Owner for review.</p> <p>5.2.6 All high temperature lines shall be provided with expansion markers with scales at certain hanger locations, as decided by the Engineer. The Contractor shall guarantee and prove during trial run, after a few cycles of operation that the range of thermal movements in three directions from cold to hot condition at the expansion marker locations are within <math>\pm 20\%</math> of the calculated values.</p> <p>If the error exceeds the above limit, necessary adjustments and rectifications shall be carried out by him at no extra cost, till the above requirement is fulfilled.</p> <p>5.3 <u>DESIGN PRESSURE &amp; TEMPERATURE</u></p> <p>As per IBR, wherever not clearly stipulated in IBR, criteria stipulated in ASME/ANSI B 31.1 for selecting design pressure &amp; temperature shall be followed.</p> |                                             |                |

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| <p>(i) Suction : 2 -3 m/sec</p> <p>(ii) Discharge : 3-6 m/sec</p> <p>(d) HP bypass</p> <p>(i) Upstream : 75 m/sec</p> <p>(ii) Downstream : 150 m/sec</p> <p>(e) LP bypass</p> <p>(i) Upstream : 75 m/sec.</p> <p>(ii) Downstream : 150 m/sec</p> <p>(f) Extraction steam</p> <p>(i) Superheated steam : 50-60 m/sec</p> <p>(ii) Saturated steam : 30-35 m/sec</p> <p>(g) Condensate</p> <p>(i) Discharge : 3-5 m/sec</p> <p>(ii) Suction : 1.5 m/sec</p> <p>(h) Heater Drains : 1.5 m/sec</p> <p>(i) Heater Vents : 25 m/sec</p> <p>(j) Other piping : As per good proven engineering practice.</p> <p><b>NOTE:</b> This standard sets the maximum limits of the flow velocity. Lower velocities may be selected, if found necessary.</p> <p>Inside diameters thus calculated shall be checked for allowable pressure drop for various systems. Pressure drop in main steam line shall not be more than 90% of the pressure differential between super heater outlet header and HP turbine inlet valves at BMCR. Similarly, combined pressure drop in cold and hot reheat piping shall not exceed 90% of the available pressure differential between HP turbine exhaust and IP turbine inlet valves</p> |                                             |                |

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| <p>minus the reheater drop. The available pressure differential in the complete reheat line from HPT exhaust to IPT inlet shall not be more than 10% of the pressure at HPT exhaust. Wherever possible, 3D/5D/6D radius bends shall be used to minimise the pressure drop in the main steam, cold &amp; hot reheat piping.</p> <p>Pipes shall be sized for the worst (i.e. maximum flow, temperature and pressure values) operating condition. In case of BFP suction pipe sizing, "transient analysis" shall be carried out for optimum sizing of the system in order to establish the pipe inside diameter for trading off between pressure drop and residence time in the suction pipe to match with the pump NPSH requirements under worst operating conditions. The Boiler Feed Discharge pipe-work shall be designed for the maximum final feed water temperature and the shut-off pressure of the boiler feed pump. Lines at downstream of HP heaters shall be designed with respective temperature of heater outlet.</p> <p>7.1.3 No pipe work shall run in trenches carrying electrical cables.</p> <p>7.1.4 Pipes shall not be less than 20 mm bore unless authorised by the Engineer.</p> <p>7.1.5 Site fabricated pipes shall be installed only where they do not exceed 50 NB and where their use has been approved in writing and shown on a scale drawing.</p> <p>7.1.6 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.</p> <p>7.1.7 Air release and drain branches shall be provided wherever necessary depending upon the layout and arranged so that the drains and air release valves are located for easy operation.</p> <p>7.1.8 All valved drains in vacuum services shall be provided with screwed cap.</p> <p>7.2 <u>METALLIC EXPANSION JOINTS</u></p> <p>The expansion joints shall be of metallic multi-bellows construction and shall be used to reduce the reactions (forces and moments) at the connected equipment terminals due to thermal expansion/contraction and/or</p> |                                                    |                |

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| <p>vibration of connected equipment and piping. The design, material, construction, manufacture, inspection, testing and performance of the expansion joints shall comply with the currently applicable requirement of EJMA, ANSI B-31.1 and all statutes, regulations and safety codes. Metallic expansion bellows are used in high temperature application line to take care of thermal expansion and movements such as axial and rotational movements.</p> <p>7.3 <u>FABRICATION</u></p> <p>Except where otherwise specified, all piping shall have butt-welded connections with a minimum of flanged joints, if necessary. All high pressure steam valves and accessories shall have welded connections. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.</p> <p>Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. All welded branches shall be reinforced where needed as per the applicable codes/regulations.</p> <p>Unless otherwise specified, for all welded lines with pressure above 7 kg/cm<sup>2</sup>(g) and/or temperature above 200°C, branch connections for branch sizes upto 25% of welded mains shall be made with special forged steel welded fittings.</p> <p>7.3.1 Piping shall be fabricated in the shop in the largest transportable sections to minimise the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.</p> <p>7.3.2 All workmanship shall be carried out using methods and procedures of best recognised pipe fabrication practice and must be done in a good and workman like manner in accordance with ANSI standards, ASME Codes, PFI standards and IBR as applicable.</p> |                                                    |                |

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| 7.3.3                                                                                                                                                | All high-pressure steam valves and accessories shall have welded connections.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |
| 7.3.4                                                                                                                                                | Mitred bends and elbows will not be accepted unless otherwise specified. Only forged tees, 90 <sup>0</sup> elbows and 45 <sup>0</sup> elbows are acceptable. In case the Bidder wants to deviate from this requirement on the ground of non-availability of such forged items, he may submit his alternative offer for Owner's consideration with sufficient documents to justify the same. In such a case, the concerned fittings shall be manufactured with necessary reinforcing pads, bend thinning allowance etc to satisfy code requirements.                                                                                                                                                                                                                |                |
| 7.3.5                                                                                                                                                | <p>All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations.</p> <p>A cross section through any bend portion of the pipe shall be true in diameter. All pipe bends shall have a radius of not less than 3 times the nominal pipe size unless otherwise mentioned. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per ANSI B 31.1. The ends of pipe and welded fittings shall be bevelled according to details shown in the relevant piping codes.</p> |                |
| 7.3.6                                                                                                                                                | For bends in pipes, straight piece of pipes shall be bent to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided at no extra cost.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |
| 7.3.7                                                                                                                                                | The ends of Pipe and welded fittings shall be bevelled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.                                                                                                                                                                                                                           |                |
| 7.3.8                                                                                                                                                | Pipes of size 50 NB and above shall be shop fabricated and of size 40 NB and below shall be field run.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |

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| 7.3.9                                                                             | <p>All welding shall be made in such a manner that complete fusion and penetration are obtained without any excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.</p> <p>Pipe and attachments shall be properly aligned prior to welding. If tack welds are used, the tacks shall be either fused into the first layer of weld or else chipped out.</p> <p>All welding for steam and feed pipe work shall be electrical welding using the shielded arc process and electrodes in accordance with the relevant code. For pipes up to and including 100 NB, provided the pipe does not exceed 12.7 mm in thickness, gas welded butt joints will be accepted without backing rings.</p> <p>Welded joints in pipe work shall be pre-heated to a temperature as required by the agreed standard or code or to the approval of the Engineer. The temperature shall be maintained during the welding operation and a record of metal temperature shall be obtained by means of a recording thermometer throughout the welding operation.</p> <p>All welds shall be built-up by the application of multiple layers or passes. The thickness of metal applied for each layer or pass shall not exceed 3 mm. Each layer shall be cleaned and lightly peeled before the next layer is applied. Before being assigned to welding work, each operator shall have passed a qualification test as prescribed in the applicable Code/ Regulations. Each approved welder shall have an identification number which shall be indicated on all welds.</p> |                |
| 7.3.10                                                                            | <p>Welded joints shall be stress relieved as per ANSI B31.1/IBR. Stress relieving temperature shall be measured by thermocouple pyrometers or other suitable equipment. Readings of temperature against time shall be recorded.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |
| 7.3.11                                                                            | <p>Bending</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |

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| <p>(a) Bend thinning allowance on straight pipe prior to bending shall be applied as per ANSI B 31.1. For bends of 5D or higher radius, the difference between maximum and minimum diameters shall not exceed 8 percent of average measured outside diameter of the pipe before bending.</p> <p>(b) All bends in 50 NB and larger piping shall be made hot. Bends in 40 NB and smaller piping may be made cold only when commercially available bending shoes are used. Finished bends shall be smooth in contour and free from buckles and distortion.</p> <p>(c) Pipe bends may be fabricated by the incremental induction heating process. Circumferential butt welds or longitudinal welds (where seamless piping has been specified) shall not be used in the arc of the pipe bends, without Engineer's permission. After bending, such welds, where permitted, shall be re-examined and re-inspected.</p> <p>(d) All piping bends are subject to heat treatment as required by the original material specification unless otherwise approved by the Engineer.</p> <p>(e) All pipe bends in 50 NB and larger piping shall be examined ultrasonically after fabrication for wall thickness conformance. Measurements shall be taken in accordance with PFI Standard ES-20 using the "Pulse Echo" method. Data reports containing information as recommended in PFI Standard ES-20 shall be forwarded to the Engineer for record purposes.</p> <p>(f) Where examination of pipe bends indicates that wall thinning has resulted in less than code required minimum wall thickness repair by weld deposit shall be allowed only where the affected area is 150 mm or less as measured along the outside arc and with Engineer's approval. Repairs in excess of this amount shall not be permitted.</p> <p>7.3.12 Branch Connections</p> <p>(a) Branch connections shall be in accordance with ANSI B-31.1 or IBR whichever is applicable. All branch connection welds shall be full penetration except as permitted by ANSI B- 31.1/IBR.</p> |                                                    |                |

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| <p>(b) Socket welding and threaded connections on pipelines shall be made by forged outlet fittings. The holes in pipe headers made for these connections shall be drilled to the same size as the fitting inside diameter. All burrs shall be removed and threaded fitting shall be repeated after welding.</p> <p>(c) For branch connection, additional reinforcements shall be provided wherever necessary by the applicable codes including supply of necessary material by the contractor at his own cost.</p> <p>(d) The design and fabrication details for the instrument stub connection are included in Tenderer's scope. Materials for instrument connection shall be the same as that of the pipe to which it is attached. Fittings ratings shall be in accordance with those specified for the main process pipe.</p> <p>7.3.13 End Preparation, Cutting etc.</p> <p>(a) For steel pipes, end preparation for butt-welding shall be done by machining/flame cutting.</p> <p>(b) Socket weld end preparation shall be saw / machine cut</p> <p>(c) For tees, laterals and other irregularities details, cutting template shall be used for accurate cutting and cutting shall follow the outline of the template.</p> <p>Alignment Considerations</p> <p>(a) The pipes joined by welding shall be aligned correctly within the existing tolerances on diameter, wall thickness and out of roundness, which shall be preserved during welding.</p> <p>(b) All flange facings shall be true and perpendicular to the axis of the pipe with boltholes being off centre.</p> |                                                    |                |

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| <p>7.3.14 Welding</p> <p>In addition to the requirements spelt out in <b>Volume II</b>, the followings shall be taken into consideration:</p> <p>7.3.14.1 Welding Process</p> <ul style="list-style-type: none"> <li>(a) Welding under this specification shall be done by one of the following processes :           <ul style="list-style-type: none"> <li>(i) Manual oxy-acetylene welding process</li> <li>(ii) Manual shielded metal arc process (SMAW)</li> <li>(iii) Manual inert gas tungsten arc process (TIG)</li> </ul> </li> <li>(b) Automatic or semi-automatic welding shall be done only with the specific approval of the Owner/Consultant.</li> <li>(c) Socket weld joint shall be done with low hydrogen type covered electrodes with manual shielded metal arc process.</li> <li>(d) Welding at any joint should be completed uninterrupted. If this procedure cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.</li> <li>(e) As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.</li> <li>(f) As a rule no backing ring shall be used for circumferential butt welds.</li> </ul> <p>7.3.14.2 Alignment and Spacing</p> <ul style="list-style-type: none"> <li>(a) Components to be welded shall be aligned and spaced. Root opening shall be as under :</li> </ul> |                                                    |                |

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| <div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>(i) For wall thickness 2.5 mm or under and for all thickness in oxy-acetylene welding</p> <p>(ii) For wall thickness over 2.4 mm</p> </div> <div style="width: 30%;"> <p>1.0 mm - 2.0 mm</p> <p>2.0 mm - 3.0 mm</p> </div> </div> <p>Special care shall be taken for fitting and alignment in case of inert gas tungsten arc welding. Flame heating for adjustment of ends is not permitted without the approval of the Owner/Consultant.</p> <p>7.3.14.3 A wire spacer of proper diameter may be used for the weld root opening but must be removed after tack welding and before application in root pass.</p> <p>7.3.14.4 Tack welding for the alignment of pipe joints shall be executed carefully and shall be free from defects since tack welds form a part of final welding. Defective welds shall be removed prior to the welding of joints. Electrode size for tack welding shall be selected depending upon the root opening.</p> <p>(a) Tacks should be equally spaced as follows:</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>(i) For 65 NB pipe and smaller</p> <p>(ii) For 80 NB to 300 NB pipe</p> <p>(iii) For 350 NB and larger pipes</p> </div> <div style="width: 30%;"> <p>2 tacks</p> <p>4 tacks</p> <p>6 tacks</p> </div> </div> <p>7.3.14.5 Welding Technique</p> <p>(a) Root pass shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.</p> <p>(b) Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxy-acetylene welding is recommended.</p> |                                                    |                |

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| <p>7.4 <u>HANGERS, SUPPORTS, ANCHORS AND RESTRAINTS</u></p> <p>7.4.1 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads.</p> <p>7.4.2 All the hangers/supports shall be of reputed make, approved/tested quality and shall have proven performance record for similar application. They shall be designed to provide the required supporting efforts and allow pipeline movement with thermal changes without causing overstress. The design shall also prevent complete release of the piping load in the event of spring failure or misalignment and all parts of supporting equipment shall be fabricated and assembled so that they will not be disengaged due to movement of the supported piping. Necessary guides, anchors, braces and structural steel to be attached to building/boiler structure as well as any braces and/or dampeners required to eliminate piping vibration and seismic loading shall be provided.</p> <p>7.4.3 In general, piping shall be supported in such a manner to maintain drainage slopes, prevent interference with structure and piping and keep flexible supports in proper adjustment so that they will move within their design operating ranges. Normally pipe supports and anchors shall be selected at those points in the building where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.</p> <p>Support spacing shall be as per good engineering practice. However, in no case it shall be less than support spacing stipulated in ANSI B31.1.</p> <p>7.4.4 The design of the pipe supports and hangers and their locations shall be guided by the following general principles:</p> <ul style="list-style-type: none"> <li>(a) Criteria of loading.</li> <li>(b) Design loads for anchors, restraints, hanger supporting structures.</li> <li>(c) Supports shall be adequate for extra loading due to hydrostatic tests and when piping system is full of water during chemical cleaning.</li> </ul> |                                                    |                |

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| <p>7.4.5</p>                                                                                                                                         | <p>(d) Supports for relief valve stacks shall be adequate for both the pipe weight and the thrust developed when the valve is open.</p> <p>(e) Besides vibration elimination, hangers shall ensure that the amplitude of oscillations in the pipe work owing to shock and vibration due to variation of fluid flow from zero to full capacity remains within approved limits.</p> <p>Attempts shall be made to use variable spring and rigid hangers as much as possible. Rigid hangers shall preferably be used where vertical movement of the pipe is negligible.</p> <p>Variable spring supports/hangers may be used provided the following conditions are met.</p> <p>(a) The variation in supporting effort between hot and cold condition does not exceed 25% of the load, which is higher of the operating condition and cold setting load.</p> <p>(b) The resulting effect of load take-up/release by a group of hangers in a span does not overstress the piping span or cause overloading at equipment terminals.</p> <p>(c) Thermal deflection between hot and cold conditions does not exceed 40 mm.</p> <p>Otherwise, constant load type support/hangers must be used. On the other hand, rigid hangers can be used where possible without exceeding the stipulated limits of terminal forces and moments and the stress subject to the Owner's/Consultant's approval.</p> <p>An exception may be made in the instance where the piping movement occurs at a hanger supporting a portion of a piping riser on which rigid support is also located. In this case, variable spring hangers may be used for any amount of expansion up to the full recommended working range of the spring, provided the change in the supporting effect of the variable spring is added to the design load of the rigid support assembly. However, the acceptance of such a system will be at Owner's /Consultant's discretion.</p> |                |

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| 7.4.6                                                                                                                                                | <p>All design and fabrication including loading and allowable stresses shall be in accordance with ANSI B31.1. Note shall be taken of the requirements against earthquake at site. Hangers and supports for systems shall be completely engineered and prefabricated for all piping 50 NB and above. Sufficient random materials shall be furnished for field support of all lines of smaller diameter.</p>                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
| 7.4.7                                                                                                                                                | <p>For pipes of design temperature 100°C and more, bottom supports shall be avoided as far as possible and hanger type supports shall only be used. However, where bottom support cannot be avoided, the same shall be provided with suitable shoes along with balls/rollers/rockers (if movement is more than 50 mm) and SS/Graphite is to be used (if the movement is more than 20 mm) to minimise frictional resistance against thermal movements. The material of shoe as well as the ball/rockers/rollers shall be suitable for the design temperature of the supported pipe and shall be of sufficient hardness so as to permit a reasonably long life keeping its roundness and maintaining a low friction factor. Where a constant load type support is required, the bottom support shall also be of constant load type.</p> |                |
| 7.4.8                                                                                                                                                | <p>The Contractor shall design and provide all supplementary steel required to properly secure and support all pipe supports, guided restraints, anchors, shock absorbers etc. Owner shall provide only the main steel work or embedded plates in the concrete.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
| 7.4.9                                                                                                                                                | <p>Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
| 7.4.10                                                                                                                                               | <p>Provision shall be made for support of piping which may be disconnected during maintenance work.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |
| 7.4.11                                                                                                                                               | <p>Supports shall be designed to prevent transfer of excessive loads from support to support as the line expands or contracts. Support components shall be attached in places where they will not damage other construction either during or after installation. Heavy piping support/Cantilever type support shall not be taken from brick wall. Brackets may be used where piping is adjacent to vertical surfaces. Brackets suitable for support use shall be supported from columns/RCC structures.</p>                                                                                                                                                                                                                                                                                                                           |                |

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| <p>Vertical restraints near safety valves shall be preferred for taking SV discharge thrust, provided equipment terminal reactions remains within allowable limit.</p> <p>Attempts shall be made to avoid use of shock absorbers, dampers etc as far as possible to take care of occasional loading like seismic effect etc by proper engineering of the piping design and effective use of restraints. However, shock absorbers, VISCO- dampers, wherever felt necessary are to be supplied and erected by the bidder.</p> <p>7.4.21 Layout of piping shall be properly designed to avoid excessive vibration by effective use of restraints. However, wherever felt necessary, shock absorbers, VISCO- dampers may be employed.</p> <p>7.4.22 Hanger rods (except rigid hangers where both tension and compression may occur) shall be subjected to tensile loading only. At hanger locations where lateral movement is anticipated, suitable linkage and rocking washers shall be provided to permit swing.</p> <p>7.4.23 For all hangers, the length of suspension shall be so selected that the hanger rod may never make an angle of more than 4° with vertical due to horizontal pipe movements. If this cannot be avoided by erecting the hanger vertically for cold condition, it shall be suitably off set so that the above requirement is fulfilled in cold as well as hot conditions. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.</p> <p>7.4.24 Hanger support rods of less than 10 mm diameter for supporting pipes 40 NB and smaller and less than 13 mm diameter for supporting pipes of 50 NB and larger, shall not be used.</p> <p>7.4.25 Supports, guides and anchors shall be so designed that excess heat will not be transmitted to the building steel.</p> <p>7.4.26 Tie rods/struts shall preferably be used for restraints to achieve low friction restraining.</p> <p>The Tie-rods/struts shall have proper arrangement and adequate length, so that, thermal movements in other directions, which are intended to be free</p> |                                                    |                |

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