INSTRUCTION TO TENDERERS

1. The Project Management Cell (PMC) invites Sealed Bids for the supply of goods to the UNDP/GEF Project of Ministry of Steel, Government of India.

2. The Bidder is expected to examine all corresponding instructions, forms, terms and specifications contained in the Tender Documents. Failure to comply with these documents will be at the Bidder’s risk and may affect the evaluation of the Bid.

3. How to Submit the offer: The Bid must comprise of two parts i.e Techno-commercial Bid and Financial Bid. These two bids will be sealed separately. The first envelop will bear the name of tenderer and the specification “Techno-commercial Offer”. The second envelop will contain the Financial Bid. This envelop will bear the name of the Tenderer and the specification “Financial Offer”. Both envelop will be introduced into a third envelop bearing the name of the tenderer and the title of Tender.

   (a) Techno-commercial Bid including documentary evidence that the goods to be supplied conform to the technical specifications with necessary literature, drawings, and data, customers reference list in India for similar job, a letter from the principal in support of appointing the Bidder as their Sole Selling Agent / Associates in India, after sales & service network etc.

Item wise confirmation on commercial terms and conditions should be furnished, as detailed below:

- **Bid Security / EMD**: Submission of EMD of Rs 300,000/- (Rs three lakhs only) by Demand Draft in favor of “UNDP/GEF Project” payable at New Delhi is mandatory. The EMD Demand Draft should be enclosed with the Techno-Commercial Bid (not with Price Bid). In absence of which the bid will be summarily rejected.
  - Bid Security / EMD of unsuccessful bidder will be discharged or returned as promptly as possible but not later than ten (10) days after the placement of order.
  - The successful Bidder’s Bid Security / EMD will be discharged or returned upon the Bidder signing the Purchase Order, and furnishing the performance Security,
  - The Bid Security / EMD may be forfeited, if the successful Bidder fails to sign the Purchase Order in accordance or does not furnish Performance Security

- **Validity of Bid**: The tender shall be submitted within 4 (four) weeks from the date of Global Tender Notice and shall be valid for a period of 3 months from the date of submission. Any bid received after the deadline of submission of bid will be rejected and will be returned unopened to the bidder.

- The tenderers must read carefully each and every item of conditions of contract as given in Annex – III and should submit in writing the confirmation / observation itemwise. Wherever they are in agreement it should be simply written as agreed.

- **Performance Guarantee**: The Tenderer shall stand guarantee of the performance guarantee parameters of their equipment / system and the time period over which the performance will be shown to the buyer.
(b) **Financial Bid:**

- Bid prices shall be fixed till validity period of the tender and shall be quoted either in Indian Rupees or US Dollar depending upon Indigenous / imported items. The prices quoted shall be CIF / FOR and shall indicate separately taxes, duties, freight, insurance, handling charges etc. If taxes and duties are not indicated the price will be taken as inclusive of same.

- Prices of spares for 2 years of operation.

- Price of consumables for 3 months, if any.

- Commissioning consumables will be treated as part of supply of equipment, the tenderers should indicate the number / quantity of each items.

- **Terms of Payment:** The tenderer should confirm the terms of payment indicated in *Annexure – III*.

4. **Procedure for Tender Evaluation:** The offers will be evaluated by a Tender Committee duly constituted for the present tender.

   The technically acceptable offer means the offer that is in full accordance with the requirements stipulated in tender specification (*Annex – II*) and which score atleast 80% marks in the Technical Evaluation. A complete proposal with the project timeline, identified milestones, etc. will carry special weightage in the evaluation of the technical bid.

   The evaluation criterion will be the UNDP evaluation system which is based on quality as well as cost, with 60% weightage for the technical bid and 40% for the financial bid.

5. **Special Notes:** UNDP/GEF Project (Steel) reserves the right not to place purchase order based on the results of this Call for Offers, in the case that circumstances change.

   Expenditures for elaboration and presentation of the Offer will be covered by the applicant and will not be reimbursed by UNDP/GEF Project.

   Requests regarding the selection results may be sent by fax to the fax number +91-11-26517568, if required.

   Offers received after the deadline will be returned to the applicants, without being opened. The other offers will be retained in UNDP/GEF Project archives.
PREAMBLE

1.1 Ministry of Steel and UNDP/GEF Project (Steel) desired to implement a program in the small scale re-rolling mills in India for energy conservation and reduction of GHG emissions. This task has been assigned to Project Management Cell (PMC), under the Ministry of Steel.

1.2 Now, the PMC is planning to install a hardware Center (TIRFAC) in the existing complex of National Institute of Secondary Steel Technology (NISST) at Mandi-Govindgarh, about 60 km from Chandigarh, as one of the activities for implementation of the programme. This institute is located adjacent to the NH-1 and is well connected by road and rail.

1.3 The proposed hardware centre will be utilized for (i) Demonstration and benchmarking of performance of walking hearth furnace, (ii) Investigation on optimal process parameters for small scale walking hearth furnaces, (iii) Development of energy efficient combustion systems for the reheating furnaces of small scale re-rolling mills, (iii) Energy efficient utilization of coal in the reheating furnaces of small scale re-rolling mills.

1.4 The following facilities will be installed in the proposed TIRFAC Hardware centre.

(i) Walking Hearth Re-heating Furnace
(ii) Bogie Hearth Furnace
(iii) Coal Gasification Unit
(iv) Captive Power Generation and Distribution Unit using High Speed Diesel.
(v) Fuel Oil storage, Heating and Pumping Unit
(vi) Cooling Water Recirculation & Supply System
(vii) Oxygen Cylinder Storage and Supply Facility
(viii) Compressed Air Supply Facility

1.5 Area layout of the proposed centre is shown in Drg. No. PMC/TIRFAC/01 Rev: R-0.

1.6 This specification covers the Design, Fabrication, Manufacture, Procurement, Inspection & Testing, supply, Delivery at site, Unloading and storage, Erection, Painting, Testing and Commissioning of (i) Walking Hearth Reheating Furnace and (ii) Bogie Hearth Furnace along with associated facilities for Billet Charging, Discharge & Transfer.

1.7 This specification also covers the Design, Fabrication, Manufacture, Procurement, Inspection & Testing, supply, Delivery at site, Unloading and storage, Erection, Painting, Testing and Commissioning of utility services of (a) Compressed Air Supply System and (b) Oxygen Supply System in the proposed TIRFAC Hardware Centre.
1.8 The above mentioned facilities are part of the TIRFAC centre. The other facilities like, (i) Power Generation & Distribution, (ii) Oil Storage and Supply System, (iii) Water supply system etc. are not covered in the scope of this tender document.

2.0 DESCRIPTION OF THE SYSTEM

2.1 General and Process Description

2.1.1 This general description of the proposed facilities consisting of Walking Hearth Furnace and Bogie Hearth Furnace with the associated billet discharge & transfer facilities and utility services (Part of TIRFAC) is for understanding of the requirement of the purchaser, to work out most appropriate design.

2.1.2 The Walking Hearth Furnace will be utilized for demonstration of effective reheating technology with this type of furnace and benchmarking of performance in the small scale re-rolling mills. Also investigations will be carried out for determining heating of different sizes and quality of billets under different heating regimes. Considering the requirement of Re-rolling Mills and stand alone Rolling Mills with steel making facilities in the small scale re-rolling sector, demonstration of operation and investigations will be carried out with cold as well as hot charge.

2.1.4 For simulating hot charge condition into the Walking Hearth Furnace, a Bogie Hearth Furnace will be installed, for pre-heating billets. In this furnace cold billets are heated to the desired temperature and then charged into the Walking Hearth Furnace for further Reheating upto rolling temperature.

2.1.5 In addition to the role of demonstration and benchmarking of performance, the Walking Hearth Furnace will also be utilized for testing of burners. It is planned to utilize this furnace for testing burners with Furnace Oil, LDO, and Producer Gas etc.

2.1.6 Testing of the burners will be limited to visual observation of flame, measurement of flame temperature at one or two points and analysis of products of combustion at one or two points in the flame. The Walking Hearth Furnace will have all the facilities, required for flame characterization of burners.

2.1.7 Area layout of the proposed centre is shown in Drg. No. PMC/TIRFAC/01 Rev: R-0. It is envisaged that the free space around the furnaces will be as per this layout. However, this layout can be changed marginally, if required.

2.1.8 The TIRFAC Hardware Centre will be utilized for demonstration purpose. Therefore, the units will be in operation on intermittent basis. The furnaces and the coal gasifier along with auxiliary facilities will be in operation for about 10 days at a stretch and then will be closed for about 15-20 days for planning of next campaign of investigations. Therefore, design of the furnaces and equipment shall take care of such intermittent operation. Design and selection of refractory materials of the furnace shall ensure capability to withstand thermal shocks. Design of equipment shall ensure smooth starting.

2.2 Description of the Walking Hearth Furnace

2.2.1 The Walking Hearth Furnace will be required for demonstration and investigations related to heating of different sizes and quality of billets. Considering this aspect, PMC has worked out the basic design parameters. The Tenderer shall furnish the main offer inline with these basic design parameters. However, if the Tenderer wishes to offer any other improved design parameters, the same may be covered under an alternative offer only.
2.2.2 The Walking Hearth Furnace will be complete with all the necessary furnace elements and design provisions, for heating the billets to a maximum temperature of 1250 °C.

2.2.3 Charging of the billets will be done by a electro-mechanical pusher from the table in front of the furnace. At the discharge end of the furnace appropriate metallic supports are to be provided for protecting the hearth during charging.

2.2.4 In addition to the charging from one end of the furnace, additional charging facility will be provided for charging hot billets at the middle of the furnace at the side wall.

2.2.5 Discharge of the billets will be done by a peel bar driven by electro-mechanical ejector mechanism.

2.2.6 There will be two types of combustion systems, viz., (i) Conventional combustion system using furnace oil and (ii) Regenerative burner combustion system using Producer Gas. At any time one of the combustion systems will be utilized.

2.2.7 Firing of Furnace Oil is done with low pressure air atomization. Alternatively, compressed air atomization may be considered.

2.2.8 Total number of firing and control zones will not be less than 2 (Two) for running the furnace in a wide range of thermal regimes.

2.2.9 The furnace will have a convective type cross flow metallic recuperator located in the flue duct below the ground level.

2.2.10 There will be a common chimney for the Walking hearth Furnace and for the Bogie Hearth Furnace.

2.2.11 The furnace shall have facility for burner testing. One of the burner ports in the soaking zone will be utilised for burner testing. Separate fuel and combustion air termination points will be made available near the designated burner.

Additional windows on the side wall of the furnace will be provided for taking samples of products of combustion from the furnace.

2.3 Description of the Bogie Hearth Furnace

2.3.1 The Bogie Hearth Furnace is required for pre-heating of billets, required for charging hot billets into the Walking Hearth Furnace. Considering this aspect, PMC has worked out the basic design parameters of this furnace. The Tenderer shall furnish the main offer inline with these basic design parameters. However, if the Tenderer wishes to offer any other improved design parameters, the same may be covered under an alternative offer only.

2.3.2 The Bogie Hearth Furnace will be complete with all the necessary furnace elements and design provisions, for heating the billets to a maximum temperature of 900 °C.

2.3.3 The furnace will be provided with a single charging door and necessary sand sealing provision.

2.3.4 On the Hearth of the Bogie, Alloy Cast Steel Skids are provided, on which the billets are charged.

2.3.5 The combustion system will be of dual fuel fired capable of firing Furnace Oil or Producer Gas at a time. Firing of the Furnace Oil is done with low pressure air atomization. Alternatively, compressed air atomization may be considered.
2.3.6 The combustion system will be on both side walls in single zone, with control for temperature and air-fuel ratio.

2.3.7 Location of burners will be such that the axes of the burners will be at the bottom of the billets. A baffle wall, with perforations, in front of the burners is provided for avoiding direct impingement of the flame. Construction of the baffle wall will be such that products of combustion will circulate above and below the billets.

2.3.8 There will be a common chimney for the Walking Hearth Furnace and the Bogie Hearth Furnace.

2.4 Description of Billet Charging, Discharge & Transfer Facilities

2.4.1 PMC has worked out schematic layout of Walking Hearth Furnace and Bogie Hearth Furnace along with charging, discharging and transfer of billets. Schematic arrangement of these facilities is presented in Drg No. PMC/TIRFAC/FURNACES/01 Rev: R-0.

2.4.2 A table (Cold Charge Table) and an electro-mechanical pusher will be provided for charging the billets into the furnace. Billets will be directly placed on the Cold Charge Table with the help of an EOT crane and pushed into the furnace by the electro-mechanical pusher.

2.4.3 Complete arrangement for discharge of billets and charging of hot billets into the furnace consists of 2 (Two) ejectors, 1 (One) Pinch Roll, 1 (One) Roller Table with charging grate, 4 (Four) roller tables for transfer of billets and 2 (Two) turn tables as designated below.

   (i)  Walking Hearth Furnace Ejector
   (ii) Pinch Roll of Walking Hearth Furnace
   (iii) Discharge Roller Table of Walking Hearth Furnace
   (iv) Yard Transfer Roller Table
   (v)  Discharge Roller Table with grate for the Bogie Hearth Furnace
   (vi) Hot Billets Transfer Roller Table
   (vii) Hot Charging Roller Table
   (viii) Transfer Turn Table
   (ix)  Hot Charging Turn Table
   (x)   Hot Charging Ejector

In addition to the above arrangement, EOT crane will be utilized for lifting the billets from the bogie hearth and for placing them on the Discharge Roller Table of Bogie Hearth Furnace.

2.4.4 The Walking Hearth Furnace Ejector will discharge billets from the furnace through side doors. The pinch roll will be utilized for pulling the billets, which are being pushed out by the ejector. The discharged billets can either be re-charged by turning them by 90 degrees at the Transfer Turn table and 90 degrees at Hot Charging Turn Table or can be sent to the yard by the Yard Transfer Roller Table.

2.4.5 The EOT crane with special hook will place the billets from the bogie on to the Discharge Roller Table with grate for Bogie Hearth Furnace. From this table the billet moves straight on to Hot Billet Transfer Roller Table, and then takes a 90 degree turn at Hot Charging Turn Table for being placed on the Hot Charging Roller Table and for charging into the furnace.
In case the billets are to be sent to the yard, they take 90 degree turn on the Transfer Roller Turn Table and move to the yard by the Yard Transfer Roller Table.

2.4.6 The billets on the Hot Charging Roller Table will be pushed into the furnace by an electro-mechanical ejector (Hot Charging Ejector)

3.0 SCOPE OF WORK

3.1 General scope of work:

3.1.1 Scope of work of the Tenderer shall be design, engineering manufacture, Inspection, Supply, Unloading & Storage, Erection, Testing and Commissioning of the total system consisting of the Walking Hearth Furnace and the Bogie Hearth Furnace complete with Billet Charging, Discharge and Transfer Facilities, consisting of charging tables and pusher for charging of cold billets, ejector for discharging of billets from the Walking Hearth Furnace, roller tables for transfer of hot billets from the Bogie Hearth Furnace to the mid-charging point of the Walking Hearth Furnace, ejector for charging the hot billets into the Walking Hearth Furnace and roller tables for transfer of hot billets to the yard, on turn-key basis.

3.1.2 The Tenderer’s scope includes design, engineering, manufacture, supply, storage, erection and commissioning of utility services of Oxygen Supply System and Compressed Air Station with distribution system on turn-key basis.

3.1.3 Design, engineering manufacture, supply, storage, erection and commissioning of any other item required for proper operation as described in the “DESCRIPTION OF THE SYSTEM” (Para 2.0) shall be in the scope of the Tenderer.

3.1.4 The Purchaser has worked out the area layout of the proposed centre is shown in Drg. No. PMC/TIRFAC/01 Rev: R-0. It is envisaged that the free space around the furnaces will be as per this layout. It is the total responsibility of the Tenderer to examine this layout with regard to charging, discharging and transfer of billets and ensure smooth charging and discharge of billets, including cold and hot billets.

3.2 Scope of work for the Walking Hearth furnace

3.2.1 The scope of work for the Walking Hearth Furnace shall include:

- Design & Engineering (to the extent required in addition to the design already provided by the Purchaser) of the complete furnace consisting of furnace chamber, combustion system, refractories & insulation, instrumentation, waste heat recovery system, mechanical equipment for walking hearth movement, etc.

- Process and structural design of the steel chimney. This chimney shall be the common chimney for the Bogie Hearth Furnace.

- Design of electrics, including motors, drive controls, Push Button Stations and cable schedules. Power feeders to MCC will be provided by the Purchaser. Power and control cable laying from the MCC room to the drives will be done by the Purchaser as per the cable scheduling given by the Tenderer.

- Design of complete instrumentation and control system of the furnace.

- Supply of all materials required for the satisfactory and efficient operation of the complete furnace as listed below and as broadly specified at Para 4.0.
• Fabricated Structurals for complete furnace, flue duct and chimney
• Castings (C.I, HRCI and HRS castings)
• Mechanical Equipment such as recuperator, walking hearth operating mechanism consisting of lifting frame and transfer frame, wheel blocks for centering and alignment hydraulic power pack, Hydraulic cylinders with drives.
• Refractory & Insulating Materials required for the entire furnace, flue line and chimney.
• Combustion Equipment for conventional burners using furnace oil firing, including burners, fuel oil pressure and flow regulation system, fuel oil flow meters, combustion air fan, atomizing air fan, combustion air flow devices, combustion air control valves, complete piping with pipe fittings and valves for fuel oil, combustion air and atomizing air etc.
• Combustion Equipment for regenerative burners using Producer Gas, including burners, reversal valves, flue duct with exhaust fan etc.
• Producer Gas distribution net work around the furnace, including pipes, pipe fittings, control and isolation valves, flow measuring orifices, purging and vent lines with valves etc.
• Instrumentation & Controls including PC-PLC system consisting of instruments for two zone temperature and air-fuel ratio control, flow meters, indicators for flow and temperature, instrument panel with complete wiring etc.
• Electrics including drive motors, MCC, local control desk, Push Button Stations, etc.
• Piping, valves & pipe fittings for hydraulics, water supply system etc.
• Any other equipment not mentioned above but required for the completeness and efficient operation of the furnace.
• Final painting with two coats of primer and two coats of finished paints to all fabricated structures as per Purchaser’s approved quality and colour code.
• Supply of commissioning spares including spare burner block and Refractories & insulation.
• Supply of first fill of oils & greases
• Supply of spares for 2 years of normal operation of the furnace

3.3 Scope of work for the Bogie Hearth Furnace.

3.3.1 The scope of work for the Bogie Hearth Furnace shall include:

- Design & Engineering (to the extent required in addition to the design already provided by the Purchaser) of the complete furnace consisting of furnace chamber, combustion system, refractories & insulation, instrumentation, waste heat recovery system, mechanical equipment for walking hearth movement, etc.

- Design of electrics, including motors, drive controls and cable schedules. Power feeders to MCC will be provided by the Purchaser. All the cabling will be done by the Purchaser as per the cable scheduling given by the tenderer.
Design of complete instrumentation and control system of the furnace.

Supply of all materials required for the satisfactory and efficient operation of the complete furnace as listed below and as broadly specified at Para 5.0.

- Fabricated Structurals for complete furnace, flue duct etc.
- Refractory & Insulating Materials for the entire furnace and flue line.
- Combustion Equipment including burner, fuel oil pressure and flow regulation system, Fuel oil flow meters, combustion air flow devices, combustion air control valves Complete piping and pipe fittings, valves for fuel oil, combustion air and atomizing air etc.
- Producer Gas distribution network around the furnace, including pipes, pipe fittings, control and isolation valves, flow measuring orifices, purging and vent lines with valves etc.
- Instrumentation & Controls including PC-PLC system consisting of instruments for single zone temperature and air-fuel ratio control, with complete wiring etc.
- Electrics including Drive motors, MCC, local control station, Push Button Stations, etc.
- Any other equipment not mentioned above but required for the completeness and efficient operation of the furnace.
- Final painting with two coats of primer and two coats of finished paints to all fabricated structures as per Purchaser’s approved quality and colour code.
- Supply of commissioning spares including spare burner block and Refractories & insulation.
- Supply of first fill of oils & greases
- Supply of spares for 2 years normal operation of the furnace.

3.4 Billet Charging, Discharge and Transfer Facilities

3.4.1 The scope of work shall include:

- Design & Engineering of material handling facilities consisting of the following:
  (i) Walking Hearth Furnace Ejector
  (ii) Pinch Roll of Walking Hearth Furnace
  (iii) Discharge Roller Table of Walking Hearth Furnace
  (iv) Yard Transfer Roller Table
  (v) Discharge Roller Table of Bogie Hearth Furnace
  (vi) Hot Billets Transfer Roller Table
  (vii) Hot Charging Roller Table
  (viii) Transfer Turn Table
  (ix) Hot Charging Turn Table
  (x) Hot Charging Ejector
Schematic presentation of the material handling facilities along with furnaces is shown in Drg. No. PMC/TIRFAC/FURNACES/01 Rev R-0.

- Design of electrics, including motors, drive controls, Push Button Stations and cable schedules. Power feeders to MCC will be provided by the Purchaser. Power and control cable laying from the MCC room to the drives will be done by the Purchaser as per the cable scheduling given by the Tenderer.

- Supply, erection and commissioning of all materials required for the satisfactory and efficient operation of the Billet Charging, Discharge and Transfer Facilities including mechanical items and electrics with drives, drive controls and push Button Stations as listed below and as broadly specified at Para 6.0.
  - Assembly of Walking Hearth Furnace Ejector
  - Assembly of Pinch Roll
  - Assembly of Discharge Roller Table of Walking Hearth Furnace
  - Assembly of Yard Transfer Roller Table
  - Assembly of Discharge Roller Table of Bogie Hearth Furnace
  - Assembly of Hot Billets Transfer Roller Table
  - Assembly of Hot Charging Roller Table
  - Assembly of Transfer Turn Table
  - Assembly of Hot Charging Turn Table
  - Assembly of Hot Charging Ejector
  - Any other equipment not mentioned above but required for the completeness and efficient operation of charging and discharge of billets.
  - Final painting with two coats of primer and two coats of finished paints to all fabricated structures as per Purchaser’s approved quality and colour code.
  - Supply of commissioning spares
  - Supply of first fill of oils & greases
  - Supply of spares for 2 years normal operation of the furnace

3.5 Scope of work for Auxiliary Utility Provisions

3.5.1 Oxygen:
The scope of the Tenderer shall be design, supply, erection and commissioning oxygen line from the gas cylinders along with pipes, valves regulators, pressure gauges, flow meter etc as per the schematic Drg No. PMC/TIRFAC/FURNACES/02 Rev R-0.

3.5.2 Compressed air:
The scope of the tenderer shall be design, engineering, manufacture / procurement, Inspection, supply, erection, testing and commissioning of 1 (one) compressor of capacity 3.0 m$^3$/min (FAD Basis) at pressure of 6.0 bar together with drive motor, base frame coupling etc. as well as compressed air pipeline as per the schematic Drg No. PMC/TIRFAC/FURNACES/03 Rev R-0.
4.0 SPECIFICATIONS OF THE WALKING HEARTH FURNACE

4.1 General Requirements:

4.1.1 Specifications of the Walking Hearth Furnace are drawn with an aim of utilizing it for demonstration of working of walking hearth mechanism, demonstration of performance with side charge of hot billets into the furnace at its mid-length. The Tenderer shall consider this aspect and shall design various features of the furnace for fulfilling this objective.

Basic design and specifications of the furnace are drawn considering the above requirements. The Tenderers are required to submit their bids with the basic design. However, any alternative schemes may be submitted as additional options.

4.2 Basic design parameters of the walking Hearth Furnace

4.2.1 Furnace useful width (between wall to wall) 3,600 mm

4.2.2 Furnace useful length between c/l flue off-take to c/l discharge) 7,000 mm

4.2.3 Inside length (between wall to wall) 9,500 mm

4.2.4 Overall outside length (shell to shell) 10,500 mm

4.2.5 Pre-heating zone effective length 2,000 mm

4.2.6 Heating zone effective length 2,500 mm

4.2.7 Soaking zone effective length 2,500 mm

4.2.8 Total connected heat load of Burners,(Max) Kcal/hr 2.4 x 10^6

4.2.9 Burners Distribution

Conventional burners with oil firing 3 Nos in Soaking Zone & 2X2 Nos in Heating Zone.

Regenerative Burners (side walls only) 3X2 Nos

4.2.10 Roof Height: Above hearth level (Soaking zone) 1,400 mm

Above hearth level (Heating zone) 1,400 mm

Above hearth top level (unfired zone) 1,400 mm

4.2.11 Waste heat recovery from flue duct Convective type

Metallic recuperator

4.2.12 Combustion Air pre-heat temperature at outlet of the recuperator. 500°C (Min)
### 4.2.13 Combustion Air pre-heat temperature through 1000°C regenerative burner

### 4.2.14 Temperature and combustion control system PC-PLC Based

**Furnace Performance**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.15 Capacity of the furnace</td>
<td>5.0 TPH</td>
</tr>
<tr>
<td>4.2.16 Maximum Percentage of scale loss</td>
<td>0.8% (Max)</td>
</tr>
<tr>
<td>4.2.17 Max heat consumption (during continuous running)</td>
<td>30 litres / t</td>
</tr>
<tr>
<td>4.2.17 Max heat consumption (during continuous running)</td>
<td>260 kcal/kg</td>
</tr>
<tr>
<td>4.2.18 Maximum Billet surface temperature at discharge, °C</td>
<td>1250 °C</td>
</tr>
<tr>
<td>4.2.19 Temperature difference between top to bottom surface</td>
<td>20 °C max</td>
</tr>
</tbody>
</table>

### 4.3 Construction Details

**4.3.1 Furnace Shell:**
Furnace shell shall be fabricated from tested quality M.S. Plates of minimum 6 mm thickness and well designed rolled steel sections (IS 2062). Wall plates at the burners shall be 10 mm thick. Hearth bottom plates shall be not less than 10 mm thickness.

**4.3.2 Furnace Roof:**
Flat Suspended roof shall be provided. Roof hangers shall be made of heat resistant steel and will be held in position though hook and anchors onto the roof steel beams.

Roof structure shall consist of large section rolled or fabricated steel beams spanning furnace width and attached to the side wall structure.

**4.3.3 Charge Door, Discharge Door, Inspection doors, clean out Doors & Breast Plates:**
All breast plates and doors shall be made of 1.8-2% Cr heat resistant castings and suitably designed to avoid warping on heating. The doors shall be lined with light weight insulating castable. The charging door shall be operated by a suitable motorized winch, while the discharge door shall be manually operated. The inspection doors shall also be manually operated.

**4.3.4 Platforms, Walkways & Hand railings**
All necessary platform with gratings and access walkways with hand railings shall be provided on the furnace for servicing the burners, valves, thermocouples and door drives etc. including all necessary structural supports, gratings / plates and hand rails. Steel stairs and cat walk ladders as are required for access to the cellar shall be provided. Hydraulic power pack shall be located in the cellar.
The platforms shall be designed for a minimum 800 Kg/sq. m load and walkways shall be designed for minimum of 500 Kg/sq. m. load.

4.3.5 Walking Hearth Structures

The walking and fixed hearths shall be designed for two row charge. Reference billet dimensions will be as below

(i) Billet cross section: 200X200 mm

(ii) Length: 1500 mm

Considering two row charging the tenderer shall design the furnace with two walking hearths and three fixed hearths.

The structural for the walking hearth and fixed hearth shall be of robust construction to withstand the duty condition. The structural platform, supporting the walking hearth, shall be made up of suitable size I-Beams and channels (IS-2062). Necessary water trough and scale trough structures shall be provided for sealing of hearth from combustion gases and for removal of scale. Necessary structural arrangement shall be provided for removal of scale from the furnace hearth to the bottom cellar from time to time during maintenance.

4.3.6 Refractory walls and roof

These shall be selected to minimise the heat losses and ensure an optimum life. All materials required for furnace proper, fixed and walking hearths, flue off take and flue duct from furnace to chimney, chimney, doors, burner blocks etc. shall be included in the scope of work such as design, Engineering, procurement, supply and erection etc.

The maximum skin temperature of the furnace shell shall be limited to 50\(^\circ\)C above ambient temperature (30\(^\circ\)C) in soaking zone, heating zone and preheating zone. The roof top maximum skin temperature shall not exceed the ambient temperature by 60\(^\circ\)C in soaking and heating zones and 50\(^\circ\)C in preheating zone.

All refractory and insulating materials shall be of reputed approved Indigenous make.

Preferred lining pattern of Furnace Roof

Soaking Zone: 250 mm thick special shaped bricks made of 60% Alumina shaped blocks backed by 50 mm thick Insulating castable.

Heating Zone: 250 mm thick special shaped Refractories 60% Alumina quality backed by 50 mm thick Insulating castable.

Pre-Heating Zone: 250 mm thick special shaped Refractories 40% Alumina quality backed by 50 mm thick Insulating castable.

NOTE: Tenderer may consider to offer 50mm thick ceramic fibre board in place of 50 mm thick insulating castable as an alternative for all the zones in the furnace roof.

Preferred lining pattern of Furnace side walls and end walls

Discharge end wall: 230 mm thick 60% Alumina quality Refractories backed by 115 mm hot face insulation bricks, 115 mm thick Mica Insulation bricks and 50 mm thick Calcium silicate blocks insulation.
Side walls (Heating & Soaking zones): 230 mm thick 60% Alumina quality refractory bricks backed by 115 mm thick hot face insulation bricks, 115 mm thick Mica Insulation bricks / Cold face insulation bricks, 50 mm thick Calcium silicate block insulation.

Side walls (Preheating Zone): 230 mm thick 40% Alumina quality (IS-8) Zone) refractory bricks backed by 115 mm thick Hot face insulation bricks, 115 mm thick Mica Insulation bricks, 50 mm thick Calcium silicate block insulation.

End wall (Charging side): 230 mm thick 40% Alumina quality (IS-8) refractory bricks backed by 115 mm thick Hot face insulation bricks, 115 mm thick Mica Insulation bricks, 50 mm thick Calcium silicate block.

Flue off take: 230 mm thick 40% Alumina quality (IS-8) refractory bricks backed by 115 mm thick Hot face insulation bricks and 115 mm Cold Face Insulation bricks.

Soaking Zone of the Hearth: 150 mm thick High Alumina fire bricks (60% Alumina) backed by 75 mm thick 40% Alumina quality firebricks, 230 mm thick cold face insulation bricks and 5 mm thick asbestos sheet.

Heating Zone of the Hearth: 150 mm thick High Alumina quality fire bricks (60% Alumina) backed by 75 mm thick 40% Alumina (IS-8) Firebrick, 115 mm thick Hot face insulation bricks, 115 mm thick cold face insulation bricks and 5 mm thick asbestos sheet.

Pre-Heating Zone of the Hearth: 150 mm thick High Alumina fire bricks (45% Alumina) backed by 75 mm thick 40% Alumina quality firebricks, 115 mm thick Hot face insulation bricks, 115 mm thick cold face insulation bricks and 5 mm thick asbestos sheet.

Charging end Doors: 175 mm thick RT128 grade ceramic fibre module backed by 25 mm thick mineral wool insulation blanket.

Discharge end Doors: 225 mm thick RT128 grade ceramic fibre module backed by 25 mm thick mineral wool insulation blanket.

Flue duct up to Recuperator: 115 mm thick IS-8 quality firebricks backed by 115 mm thick Mica insulating bricks and 50 mm thick calcium silicate block insulation.

Flue duct from Recuperator up to chimney: 115 mm thick IS-6 quality firebricks backed by 115 mm thick Mica insulating bricks.

Recuperator area: 115 mm thick IS-8 quality firebricks backed by 115 mm thick Mica insulating bricks and 50 mm thick calcium silicate block insulation.

4.3.7 Combustion System

4.3.7.1 General Requirement

The furnace shall be provided with two types of combustion systems, viz., (i) With Conventional Burners for firing of Furnace Oil/LDO and (ii) With Regenerative Burners for Producer Gas firing.

Design of location and heat load distribution shall be such that at any time only one of the combustion systems will be working.

The proposed scheme of burner locations by the Purchaser is in Drg. No. PMC/TIRFAC/FURNACES/04 Rev R-0. The tenderer may choose this scheme in his design or may opt for any other scheme, which shall meet the requirement of using either conventional burners or regenerative burners at a time.
4.3.7.2 Combustion system with conventional oil fired burners:
The combustion system with conventional burners with furnace oil firing shall be complete in all respects with adequate heat load so that the furnace can be run with this system alone.

The furnace shall be designed with at least two firing zones. One zone shall be the ‘Soaking Zone’ with end fired burners. The other zone shall be the ‘Heating Zone’ with side fired burners.

The furnace firing profile, size of burners in each zone and type of firing shall be as designed for an efficient, economical and uniform heating of billets with minimum scale loss.

Atomization of oil can be with either high pressure blower air or with compressed air.

The capacity of the combustion system for each zone and as a whole shall be at least 20% more than that required at the maximum rated furnace output.

The tenderer shall supply the burner including the below listed accessories.

- Airside flexible bellows Manual hot air butterfly valve
- Flexible hose for oil
- Manual oil shutoff valve
- Flexible hose for atomizing air
- Atomizing air ball valve

Construction of the burners shall be robust with alloy steel.

Furnace oil supply system: Furnace Oil will be available at the battery limits of about 8.0 m from the furnace at a pressure of 8.0 bar. Design, supply, erection and commissioning of Furnace Oil distribution network around the furnace for supply of oil to the burners shall be in the scope of the Tenderer. The oil distribution network shall be complete with pressure reducer valves, oil flow meter, isolation valves, flow regulation valves, filters, flexible hoses pipes and pipe fittings. The oil distribution network shall be connected to the return line of the Central Furnace Oil Supply System.

All the pipes for the oil distribution network shall be seamless pipes confirming to IS 1239 Part-1. Wall thickness of the pipes shall not be less than 5.0 mm.

The oil flow meter shall be of mass flow meter type.

Oil pressure regulation system shall be for a range of regulation from 8.0 bar to 2.5 bar.

For flow regulation micro valve of Hack make with 150 degree turn electrical actuator may be used as an alternative.

Producer Gas supply system: Producer gas will be available at the battery limits of about 18.0 m from the furnace at a pressure of 1000 mm WC. Producer gas distribution network around the furnace shall be provided by the tenderer. The gas distribution network shall be complete with isolation valves, flow orifice, flow regulation valve, pipes and pipe fittings.

All the pipes for the oil distribution network shall be ERW pipes confirming to IS 1239 Part-1. Wall thickness of the pipes shall not be less than 5.0 mm.
Combustion Air Blower: One combustion air blower complete with drive motor, couplings, suction damper and base frame shall be provided for supply of combustion air. Flow capacity and pressure rating shall be designed by the tenderer. The same combustion air blower shall be used for the Regenerative Burners also. The Tenderer shall design the pressure rating of the blower considering the requirement of the Regenerative burners.

Electrical drive and control system of the combustion air blower shall confirm to the specifications given in Annexure-IIa.

Atomizing Air Blower: One atomizing air blower complete with drive motor, couplings, suction damper and base frame shall be provided, for supply of atomizing air to the burners. Flow capacity and pressure rating shall be designed by the tenderer. In case the tenderer provides burners with compressed air atomization of furnace oil, atomizing air blower may not be provided.

Electrical drive and control system of the Atomising air blower shall confirm to the specifications given in Annexure-IIa.

Combustion Air Piping and atomizing air piping: Design, supply, erection and commissioning of the combustion air pipeline from combustion air blowers to recuperator and hot air piping from the recuperator to the burners shall be the scope of work for the Tenderer. The pipe line supports, expansion joints and connecting flanges and joints shall be provided as necessary. The hot combustion air pipeline and it’s valves & fittings shall be made out of SS grade AISI-304 material.

Complete piping as required including valves & fittings and instruments for supply of atomizing air from the atomizing air blowers up to the burners shall be provided.

The cold air pipeline shall be provided with by-pass line before the recuperator for supply of air to the Regenerative Burners. A separate cold air pipeline network with necessary flow measuring devices, control valves, isolation valves etc for each zone of Regenerative Burners shall be provided.

Insulation of hot air pipes: Hot air pipe lagging shall be with mineral wool blankets. Thickness of the insulation shall be 75 mm minimum. The insulation shall be covered by galvanised chicken mesh and aluminium / galvanised sheet of 22 SWG.

4.3.7.3 Combustion system with regenerative burners

Design, Engineering, supply, erection, testing and commissioning of Regenerative Burners using Producer Gas shall be in the scope of the Tenderer. Separate exhaust fan and combustion air fan shall be provided for the regenerative burners.

Scope of supply for the tenderer shall be the required number of regenerative burners complete with reversal valves, isolation valves for both gas and air and any other component required for regenerative burners.

Regenerator of the burner system shall be Honey comb / Pebble type made up of 90% alumina.

Make of the regenerative burners shall be of world reputed companies like Hotwork, UK, Bloom Burners, USA or any other equivalent makes.

Separate exhaust system, including an exhaust fan, for regenerative burners shall be designed, supplied and erected. This exhaust duct shall be connected to the main flue duct before the inclined damper. The flue duct shall be insulated inside with mineral wool of density 128 kg/m³. Alternatively, insulating castable of atleast 150mm thickness may be used.
4.3.8 Waste Heat Recovery System:

The system will be designed with metallic recuperator and with necessary protection for high inlet temperature of flue gases.

**Recuperator:** A multi-channel Tubular Cross-Current flow Type Recuperator shall be provided in the flue duct for preheating the combustion air, as per the below specifications

(i) Inlet temperature of flue: 900 °C
(ii) Maximum flue temperature: 1000 °C
(iii) Inlet air temperature: 30 °C
(iv) Air pre-heat temperature at outlet: 500 °C
(v) Pressure drop across the air side: < 200 mm WC
(vi) Pressure drop across flue side: < 15 mm WC.

Volume of flue gases and combustion air shall be as per the design of combustion system.

The materials selected for tubes in different passes shall be suitable for the temperature of flue gas and combustion air. Tube bundle of the first pass of the recuperator from inlet flue side shall be made out of HRS grade AISI-310. The second pass of the tube bundle shall be made up of seamless carbon steel tubes conforming to ASTM A-106 Grade.

**Dilution Air Blower:** A centrifugal blower with drive motor shall be provided for waste gas dilution to protect the recuperator. A control valve with electrical actuator shall be provided for regulation of flow of dilution air. The control valve shall be actuated automatically in the event of excess temperature of inlet flue gas to the recuperator.

**Hot Air Bleed System:** A hot air bleed system with automatic control shall be provided to give further protection to the recuperator. The hot air, which will be exhausted, shall be piped back into the waste gas duct after the recuperator.

4.3.9 Flue system

The flue gas from the furnace shall be passed through an underground flue tunnel to the chimney. The flue tunnel shall be suitably sized and refractory lined. Recuperator and Damper shall also be installed below the ground level.

The velocity of flue gases in the flue tunnel shall not exceed 3.0 Nm/sec.

**Damper:** The damper for the furnace pressure control shall be located in the waste gas channel between recuperator and chimney. The damper shall be made out of stainless steel plate and shaft of grade AISI-304. It shall be operated either by an electric actuator or by a pneumatic cylinder with electro-pneumatic positioner. Control function shall be performed through the computer.

**Chimney:** A natural draught self supporting chimney, lined inside up to 50% of the height with insulating material shall be provided. It shall be fabricated from mild steel plates suitably reinforced. It shall be fabricated in sections of suitable lengths for ease of transportation and installation. Lightening Arrestor, Earthing, an indication lamp at the top, Access ladder and hooks for painting etc. shall be provided. Helical reinforcing ribs shall be provided at the top 10 m section to avoid vibration and oscillation due to wind load.
Necessary sampling points shall be provided. Chimney shall have access door for maintenance. Platforms, walkways, hand railings and cat ladders with cage, shall be provided upto top. The all-round platform shall be provided at every 5m interval. The thickness of shell plate of chimney from base up to top of chimney shall be suitably designed considering the standard wind load condition and structural stability. In general the chimney shall be constructed as per IS-6533. The velocity of the flue gases in side the chimney shall be not more than 3 m/sec with Nm$^3$ volume condition of the flue gas. Calculation justifying design of chimney shall be furnished. The minimum height of the chimney shall not be less than 30.0 m above ground level.

No by-pass flue line for the recuperator shall be provided. In the event of recuperator being removed for maintenance / repair, a separate ceramic fibre lined, MS steel cover shall be provided to close the flue duct at the top in the recuperator opening. However, combustion air by-pass to operate the furnace with cold air shall be provided.

4.3.10 Hydraulic equipment

For the operation of charging pusher, discharge ejector, walking beam operating mechanism for lifting and forward motion, necessary hydraulic power pack, piping and hydraulic cylinders shall be provided. The hydraulic power pack shall be complete with tank and accessories, working and stand-by pumps, valve panels, interconnecting piping & valves, hoses, pressure gauges, temperature gauges, oil cooler, level switches, filters etc. The hydraulic power pack shall be of reputed proven make.

Drives for the hydraulic pumps with electrical controls shall be provided by the Tenderer. Electrical control panel shall be located near the drive. Feeder to the drive shall be provided by the Purchaser.

Audio-visual alarm for the following fault conditions shall be provided at local panel for hydraulic system besides provision of M.C.C and startup push buttons for motors:

- **Low level of oil in tank**
- **High temperature of oil**
- **Filter clogging**
- **Low pressure in the system**

Group fault shall be annunciated in the control console.

4.3.11 Instrumentation & Control System

The furnace shall be designed with two control zones. The control loops for each zone shall be (i) Furnace Temperature control and Excess temperature control (ii) Air-fuel ratio control.

In addition to the above zonal controls the following controls for the entire furnace shall be provided

(i) Furnace pressure control
(ii) Combustion air pressure control

In addition to the two zonal control thermocouples, three additional thermocouples shall be provided for temperature mapping of the furnace

The following safety controls shall be provided
(i) Producer gas shut off during low combustion air pressure  
(ii) Furnace oil shut off during low combustion air pressure and low fuel oil pressure  
(iii) Control of flue inlet temperature before the recuperator through dilution air fan  
(iv) Hot air bleeding

The control system shall be PLC based. HMI station with lap top computer of reputed make with latest configuration and necessary communication and MIS software shall be provided.

The instrumentation & Control system shall allow efficient operation of the furnace with a Burner Turn-Down Ratio of atleast 5:1.

Design, Engineering, supply, erection, testing and commissioning of the complete instrumentation and control system package consisting of thermocouples, temperature transmitters, compensating cables, flow orifices, oil and gas flow meters, differential pressure transmitters, pressure transmitter, control valves with actuators, I/O signal cables, conduits, junction boxes, indicators, signal dividers etc. shall be scope of the Tenderer.

Scope of work shall include instrumentation and control system for both types of combustion systems, viz., (i) Combustion system with conventional burners using furnace oil and (ii) Combustion system with regenerative Burners using Producer Gas.

The Tenderer shall provide P&I Diagram and list of instruments with specifications along with his quotation.

**Instrument panel:** All the instruments on a panel will be installed in the Control Room (Item No. 15 of the Drag No PMC/TIRFAC/01 Rev R-0). The instrument panel shall be provided for housing all instruments connected with furnace temperature control; necessary solid state annunciation windows, signaling and indicator lamps etc. The instrument panel shall house all the instruments of the Walking Hearth Furnace and The Bogie Hearth furnace.

Instrument panel shall be simplex type, free standing, floor mounted, front attended, totally enclosed, dust & vermin proof enclosures with IP-54 degree of protection having base channel ISMC 100.

Instrument Panel shall be made of 2 mm minimum thickness CRCA sheet with blank removable cable gland plate of 3 mm thick CRCA sheet steel at the bottom.

Necessary power supply required for instrument panel shall be generated in the panel itself. Incoming feeder shall be from MCC.

For control, metering and annunciation circuits, wiring shall be done with multi stranded copper conductor of 1100 V grade PVC insulated flexible wire. Accordingly terminal block shall be suitable for 2.5 sq. mm stranded wire.

If any special cables required for instrument panel shall be supplied, laid and terminated.
5.0 SPECIFICATIONS OF THE BOGIE HEARTH FURNACE

5.1 Specific Requirements:

5.1.1 Specifications of the Bogie Hearth Furnace are drawn with an aim of utilizing it for pre-heating of billets, which will be used for hot charging into the Walking Hearth Furnace. The Tenderers shall consider this aspect and shall design various features of the furnace for fulfilling this objective.

Basic design and specifications of the furnace are drawn considering the above requirements. The Tenderers are required to submit their bids with the basic design. However, any alternative schemes may be submitted as additional options.

5.2 Basic design parameters

<table>
<thead>
<tr>
<th>5.2.1</th>
<th>Batch weight</th>
<th>5.0 t</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.2</td>
<td>Furnace chamber width (between inside wall to wall)</td>
<td>2,500 mm</td>
</tr>
<tr>
<td>5.2.3</td>
<td>Furnace chamber inside length</td>
<td>4,000 mm</td>
</tr>
<tr>
<td>5.2.4</td>
<td>Furnace chamber height above hearth level</td>
<td>1500 mm</td>
</tr>
<tr>
<td>5.2.5</td>
<td>Total connected heat load</td>
<td>$2.4 \times 10^6$ kcal/hr</td>
</tr>
<tr>
<td>5.2.6</td>
<td>Maximum furnace temperature</td>
<td>1200°C</td>
</tr>
<tr>
<td>5.2.7</td>
<td>Fuels to be used through dual fuel burners</td>
<td>Furnace Oil / Producer gas</td>
</tr>
<tr>
<td>5.2.8</td>
<td>Length of the bogie</td>
<td>4,500 mm</td>
</tr>
<tr>
<td>5.2.9</td>
<td>Width of the bogie</td>
<td>2,300 mm</td>
</tr>
<tr>
<td>5.2.10</td>
<td>Number of burners in two side walls</td>
<td>4X2</td>
</tr>
</tbody>
</table>

5.3 Construction Details

5.3.1 Furnace Shell:

Furnace shell shall be fabricated from tested quality M.S. Plates of minimum 6 mm thickness. Well designed rolled steel sections (IS 2062) not exceeding a span of 1000mm shall be provided all around the side walls and end walls. Wall plates at the burners shall be 10 mm thick. Bogie structure shall be made out of robust construction with large section rolled I-beams and channels of suitable size.

5.3.2 Furnace Roof:

Flat roof suitable for lining with ceramic fibre modules shall be provided. Roof construction shall be modular in 3 to 4 modules. Roof structure shall consist of large section rolled or fabricated steel beams spanning furnace width and attached to the side wall structure.
5.3.3 Bogie Door, Inspection doors, & Breast Plates:
All breast plates shall be made of 1.8-2% Cr heat resistant castings and suitably designed to avoid warping on heating. The door shall be fabricated from tested quality M.S. Plates of minimum 6 mm thickness and well designed rolled steel sections (IS 2062). The bogie door shall be operated by a suitable motorized winch. The inspection doors shall be manually operated.

5.3.4 Platforms, Walkways & Hand railings
All necessary platform with gratings and access walkways with hand railings shall be provided on the furnace for servicing the burners, valves, thermocouples and door drives etc. including all necessary structural supports, gratings / plates and hand rails. Steel stairs and cat walk ladders as are required for access to the cellar shall be provided. Hydraulic power pack shall be located in the cellar.

The platforms shall be designed for a minimum 800 Kg/sq. m load and walkways shall be designed for minimum of 500 Kg/sq. m load.

5.3.5 Bogie
The bogie shall be designed for movement with Rack & Pinion drive mechanism. The drive and gear box shall be placed below the ground level.

The structurals for the bogie shall be of robust construction to withstand the duty condition load as well as temperature. The Bogie shall be fabricated from tested quality of Rolled Steel Sections (IS : 2062). The Hearth top plate shall be minimum 10mm thick M.S plate of tested quality.

Sealing of the bogie shall be with sand.

5.3.6 Refractory walls, roof and bogie
Refractory lining of the walls above the burner level shall be done by ceramic fibre modules of below specification

<table>
<thead>
<tr>
<th>Specification of ceramic fibre lining modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al$_2$O$_3$ %</td>
</tr>
<tr>
<td>SiO$_2$ %</td>
</tr>
<tr>
<td>ZrO$_2$</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>Specific heat capacity, Kj/kg °K at 980 °C</td>
</tr>
<tr>
<td>Tensile strength (kpa)for 128 kg/m$^3$ blanket</td>
</tr>
<tr>
<td>Liner expansion (% after 24 hours of firing)</td>
</tr>
<tr>
<td>Leachable chloride content</td>
</tr>
</tbody>
</table>

Maximum skin temperature of the furnace shell and roof shall be limited to 50°C above ambient temperature.
Below the burner level the walls will be constructed with 230 mm thick 60% Alumina quality Refractories backed by 115 mm hot face insulation bricks, 115 mm thick Mica Insulation bricks and 50 mm thick Calcium silicate blocks insulation. The Baffle wall shall be made up of 60% Alumina quality Refractory bricks.

The Bogie Hearth shall be made of pre-fired bricks or in-situ cast LCC. Refractory of hearth shall be designed for a skin temperature not exceeding 50 °C above the ambient temperature.

All refractory and insulating materials shall be of reputed approved make as indicated in Annexure - IIa.

5.3.7 Combustion System

The Bogie Hearth Furnace shall be provided with a combustion systems using furnace oil and producer gas. The combustion system shall be with single zone and with side burners on both sides.

The tenderer shall design the combustion system for the following parameters.

(i) Reference Billet size: 200X200X1500 mm.
(ii) Duration of heating & soaking: 3 hours
(iii) Material grade: Carbon steels
(iv) Maximum discharge temperature of the billets: 900 °C.
(v) Temperature difference from Top to Bottom: 20 °C (Max)
(vi) Batch weight: 5.0 t

The tenderer shall design the combustion system to meet the above requirements. Number of burners and capacity of each burner shall be designed by the tenderer. Preferred number of burners shall be 4 on each side of the wall for achieving uniform heating.

The capacity of the combustion system for each zone and as a whole shall be at least 20% more than that required at the maximum rated furnace output.

**Burners:** The burners shall be dual fuel fired capable of firing either Furnace Oil or Producer Gas at a time. The burners shall be designed for suitable flame of short length to avoid direct flame impingement.

**Producer Gas supply system:** Producer gas will be available at the battery limits of about 15.0 m from the furnace at a pressure of 1000 mm WC. Producer gas distribution network around the furnace shall be provided by the tenderer. The gas distribution network shall be complete with isolation valves, flow orifice, flow regulation valves pipes and pipe fittings.

All the pipe for the oil distribution network shall be ERW pipes confirming to IS 1239 Part-1. Wall thickness of the pipes shall not be less than 5.0 mm.

**Furnace oil supply system:** Furnace oil will be available at the battery limits of about 8.0 m from the furnace at a pressure of 8.0 bar. Furnace oil distribution network around the furnace for supply of oil to the burners shall be designed and installed by the tenderer. The oil distribution network shall be complete with pressure reducer, oil flow meter, isolation valves, flow regulation valves, filters, flexible hoses pipes and pipe fittings. The oil distribution network shall be connected to the return line of the Central Furnace Oil Supply System.
All the pipe for the oil distribution network shall be seamless pipes confirming to IS 1239 Part-1. Wall thickness of the pipes shall not be less than 5.0 mm.

The oil flow meter shall be of mass flow meter type.

Oil pressure regulation system shall be for a range of regulation from 8.0 bar to 2.5 bar.

For flow regulation micro valve of Hack make with 150 degree turn electrical actuator may be used.

**Combustion Air Blower:** One combustion air blower complete with drive motors, couplings, suction damper and base frame shall be provided for supply of combustion air. Flow capacity and pressure rating shall be designed by the tenderer.

**Atomizing Air Blower:** One atomizing air blower complete with drive motors, couplings, suction damper and base frame shall be provided, for supply of atomizing air to the burners. Flow capacity and pressure rating shall be designed by the tenderer. In case the tenderer provides burners with compressed air atomization of furnace oil, atomizing air blower may not be provided.

**Combustion Air Piping and atomizing air piping:** Necessary combustion air pipe line from combustion air blowers to recuperator and hot air piping from the recuperator to the burners shall be included. The pipe line supports, expansion joints and connecting flanges and joints shall be provided as necessary. The hot combustion air pipeline and it’s valves & fittings shall be made out of SS grade AISI-304 material. Complete piping as required including valves & fittings and instruments for supply of atomizing air from the atomizing air blowers up to the burners shall be provided.

**Insulation of hot air pipes** Hot air pipe lagging shall be with mineral wool blankets. Thickness of the insulation shall be 50 mm minimum. The insulation shall be covered by galvanised chicken mesh and aluminium / galvanised sheet of 22 SWG.

5.3.8 Waste Heat Recovery:

The waste heat recovery system will be designed with metallic recuperator and with necessary protection for high inlet temperature of flue gases.

**Recuperator:** A multi-channel Tubular Cross-Current flow Type Recuperator shall be provided in the flue duct, to preheat the combustion air as per the below specifications

(i) Inlet temperature of flue: 800 °C
(ii) Maximum flue temperature: 900 °C
(iii) Inlet air temperature: 30 °C
(iv) Air pre-heat temperature: 400 °C
(v) Pressure drop across the air side: < 200 mm WC
(vi) Pressured drop across flue side: < 15 mm WC.

Volume of flue gases and combustion air shall be as per the design of combustion system.

The materials selected for tubes in different passes shall be compatible with the temperature of flue gas and combustion air. Tube bundle of the first pass of the recuperator from inlet flue side shall be made out of SS grade AISI-310. The second pass of the tube bundle shall be made up of carbon steel tube having 13% chromium.
5.3.9 Flue system
The furnace shall be provided with two flue ports, at the burner level, on both sides of the furnace chamber. Flue ducts from both the ports shall be joined together and run on one side of the furnace. Waste heat recovery system shall be provided in flue duct above the ground level. The velocity of flue gases in the flue duct shall not exceed 3.0 Nm/sec.

The overhead flue duct shall be fabricated with MS plates confirming to IS 2062 and insulated with ceramic fibre inside. The ceramic fibre used before the recuperator shall be of high temperature grade with 17% Zirconia. The ceramic fibre lining shall be coated suitably with abrasive resistant material.

After the recuperator the duct shall be lagged with mineral wool blankets. Thickness of the insulation shall be 75 mm minimum. The insulation shall be covered by galvanised chicken mesh and aluminium / galvanised sheet of 22 SWG.

**Dampers:** The damper for the furnace pressure control shall be located in the waste gas channel between recuperator and chimney. The damper shall be made out of stainless steel plate and shaft of grade AISI-304. It shall be operated either by an electric actuator or by a pneumatic cylinder with electro-pneumatic positioner. Control function shall be performed through the computer.

In addition to the pressure regulation damper, inclined isolation damper shall be provided in the flue lines for isolation of the Bogie Hearth Furnace from the chimney when this furnace is not in use.

**Chimney:** Chimney for the Bogie Hearth Furnace will the common chimney of the Walking Hearth Furnace. Hence additional chimney is not to be provided for this furnace.

5.3.11 Instrumentation & Control System
The furnace shall be designed with control loops for (i) Temperature control and excess temperature control (ii) Air-fuel ratio control.

In addition to the above zonal controls the following controls for the entire furnace shall be provided

(iii) Furnace pressure control
(iv) Combustion air pressure control

In addition to the zonal control thermocouples, three additional thermocouples shall be provided for temperature mapping of the furnace

The following safety controls shall be provided

(v) Furnace oil shut off during low combustion air pressure and low oil pressure
(vi) Control of flue inlet temperature before the recuperator through dilution air fan

The control system shall be PLC based. HMI station with lap top computer of latest configuration, reputed make and necessary communication and MIS software shall be provided.

The instrumentation & Control system shall allow efficient operation of the furnace with a Burner Turn-Down Ratio of 5:1
Design, supply, erection and commissioning of the complete instrumentation and control system package consisting of thermocouples, temperature transmitters, compensating cables, flow orifices, oil and gas flow meters, differential pressure transmitters, pressure transmitter, control valves with actuators, I/O signal cables, conduits, junction boxes, indicators, signal dividers etc. shall be scope of the Tenderer.

Scope of work shall include instrumentation and control system for both the fuel firing viz., (i) Furnace Oil and (ii) Producer Gas.

The Tenderer shall provide P&I Diagram and list of instruments with specifications along with his quotation showing each of the two fuel system.

**Instrument panel:** The instrument panel shall be common with that of the Walking Hearth Furnace.

### 6.0 SPECIFICATION OF BILLET CHARGING, DISCHARGING AND TRANSFER

#### 6.1 Charging of billets into the Walking Hearth Furnace:

The charging facility at the charging end of the Walking Hearth Furnace shall consist of a table (Cold Charge Table) and a electro-mechanical pusher.

The Cold Charge Table shall be of 2000 mm long suitable for accommodating 10 billets of cross section from 200X200. Width of the Cold Charge Table shall be about 3500 mm to accommodate two row charge of billet length 1500 mm maximum.

The electro-mechanical pusher shall be with rack and pinion mechanism having a travel distance of 3000 mm. The pusher shall be designed for load of billets with cross section 300X300 mm.

#### 6.2 Ejector and Pinch Roll of Walking Hearth Furnace

The Tenderer shall design, supply install and commission the Walking Hearth furnace Ejector and Pinch Rolls confirming to the below specification.

<table>
<thead>
<tr>
<th>Type of drive</th>
<th>AC motor with suitable controls and with gear box.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type ejecting rod</td>
<td>Solid alloy steel rod with water cooling out side in a trough through sprays.</td>
</tr>
<tr>
<td>Travel distance of ejecting rod</td>
<td>4500 mm Maximum</td>
</tr>
<tr>
<td>Proposed length of ejecting rod</td>
<td>6500 mm</td>
</tr>
<tr>
<td>Speed of the ejecting rod</td>
<td>Dual speed with about 300 mm/sec for forward movement and about 600 mm/sec for retreating</td>
</tr>
<tr>
<td>Cycle time</td>
<td>Less than 60 seconds</td>
</tr>
<tr>
<td>Drive mechanism</td>
<td>The pushing rod is required to travel by two friction rolls. Drive is to be provided for the bottom roll. Top roll shall rotate by friction. A suitable manually adjusted mechanism for providing necessary grip between the roll is to be provided.</td>
</tr>
</tbody>
</table>
Lateral movement | Lateral movement of the entire billet ejecting mechanism for alignment of the ejecting rod with the adjacent billet.  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral travel distance</td>
<td>600 mm</td>
</tr>
<tr>
<td>Lateral travel drive</td>
<td>Hydraulic cylinder</td>
</tr>
</tbody>
</table>

Cooling of driving rolls | Water cooling with water spray jets |

Driving rolls material | Forged alloy steel |

### Specifications of the Pinch Rolls:

<table>
<thead>
<tr>
<th>Type of drive</th>
<th>AC motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of the rolls</td>
<td>About 300 mm</td>
</tr>
<tr>
<td>Roll gap adjustment</td>
<td>Manual with screw down mechanism</td>
</tr>
<tr>
<td>Speed</td>
<td>700 mm/sec</td>
</tr>
<tr>
<td>No of drive rolls</td>
<td>Two</td>
</tr>
<tr>
<td>Control mechanism</td>
<td>Proper synchronization between the ejector and the pinch rolls is to be provided. Common travel distance of the billet by ejector as well as by the pinch rolls shall be 500 mm. Operation of the pinch roll, ejector and pusher is to be accomplished by a single button.</td>
</tr>
</tbody>
</table>

### 6.3 Roll Tables:

All the roller tables shall be with individual motor for each roll.

Motor controls shall be according to the specifications mentioned in *Annexure - IIa* of this tender document.

The tenderer shall design, supply, install and commission the roller tables with the basic design parameters, as given below, provided by the purchaser.

Roll diameter: 300 mm

Pitch: 450 mm

Drives: Geared Electric Motor drives for individual rolls

### 6.4 Turn Tables

Both turn tables, viz., (i) Transfer Turn table and (ii) Hot Charge Turn Table shall be manually driven. The construction shall be rugged using MS and alloy steel material. Table top shall be with high manganese wear resistant steel.

### 6.5 Hot Charging Ejector

The Tenderer shall design, supply install and commission the Hot Charging Ejector confirming to the below specification.
<table>
<thead>
<tr>
<th>Type of drive</th>
<th>AC motor with suitable controls and with gear box.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type ejecting rod</td>
<td>Solid alloy steel rod with water cooling outside in a trough through sprays.</td>
</tr>
<tr>
<td>Travel distance of ejecting rod</td>
<td>6600 mm Maximum</td>
</tr>
<tr>
<td>Proposed length of ejecting rod</td>
<td>8500 mm</td>
</tr>
<tr>
<td>Speed of the ejecting rod</td>
<td>Dual speed with about 300 mm/sec for forward movement and about 600 mm/sec for retreating</td>
</tr>
<tr>
<td>Cycle time</td>
<td>Less than 60 seconds</td>
</tr>
<tr>
<td>Drive mechanism</td>
<td>The pushing rod is required to travel by two friction rolls. Drive is to be provided for the bottom roll. Top roll shall rotate by friction. A suitable manually adjusted mechanism for providing necessary grip between the roll is to be provided</td>
</tr>
<tr>
<td>Lateral movement</td>
<td>Lateral movement of the entire billet ejecting mechanism for alignment of the ejecting rod with the adjacent billet. Lateral travel distance 600 mm Lateral travel drive: Hydraulic cylinder</td>
</tr>
<tr>
<td>Cooling of driving rolls</td>
<td>Water cooling with water spray jets</td>
</tr>
<tr>
<td>Driving rolls material</td>
<td>Forged alloy steel</td>
</tr>
</tbody>
</table>

### 7.0 SPECIFICATIONS OF AUXILIARY UTILITY FACILITIES

#### 7.1 Oxygen supply system:

Bank of oxygen cylinders will be available in the Oxygen Storage Room as shown in the Drg. No. PMC/TIRFAC/01 Rev R-0.

Scope of the tenderer shall be design, engineering, manufacture, supply, erection testing and commissioning of the oxygen manifold, pipelines with all the pipe fittings, flow meter and valves as shown in Drg. No. PMC/TIRFAC/FURNACES/06 Rev R-0.

All the pipes shall be stainless steel seamless pipes of grade AISI 304, with wall thickness not less than 5.0 mm. All the pipe fittings and valves etc. shall be of stainless steel grade AISI 304.

The Tenderer shall supply, install and commission flow meter for oxygen. The oxygen flow meter shall be of vortex type with indicator and integrator.

#### 7.2 Compressed air supply system:

Compressed air supply system shall be complete with compressor, air receiver tank and pipeline including valves, pipe fittings, flow meter, pressure reducer hoses etc.
The scope of the tenders shall be supply, erection and installation of one compressor of capacity 3.0 m$^3$/min (FAD Basis) at pressure of 6.0 bar. The compressor shall be of screw type compressor with electrical motor confirming to the specifications given in Annexure-IIa.

All the pipes and pipe fittings shall be MS seamless pipes with wall thickness not less than 5.0 mm.

The Tenderer shall supply, install and commission flow meter for compressed air. The flow meter shall be of vortex type with indicator and integrator.

### 8.0 PAINTING

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, and derusted.

- Equipment shall be painted by power coating and backing process to withstand heavily polluted environment.
- Equipment shall receive two coats of anti rust paint before coating with two coats of final paint.
- Paint shall be EPOXY, glossy, with a colour shade to be specified by the Purchaser.

### 9.0 DESIGN STANDARDS, GENERAL CLAUSES AND INSTRUCTIONS

#### 9.1 Design standards

The equipment and materials shall be in accordance with the relevant standards of the Bureau of Indian Standards. Wherever Indian Standards do not exist, components shall be designed, assembled and tested in accordance with the modern practice prevailing in the field taking into consideration International standards such as BS/ASA.

The equipment and materials shall also be designed in accordance with the latest Indian Electricity Rules and Electricity Rules Prevailing in the state as regards the safety, Earthing and other associated provisions specified therein for installation and operation of electrical equipment.

The requirements of ‘Central Board for the Prevention & Control of Pollution’ shall be considered in the design of the chimney. The chimney shall be generally designed inline with the requirement indicated in IS-6533. The chimney shall be lined upto one third of it’s height with suitable refractory and insulation lining to withstand the desired temperature condition.

All drawings and documents shall be in English language.

#### 9.2 General clauses and instructions

9.2.1 The tender specification covering design, supply, erection and commissioning of the (i) Walking Hearth Furnace, (ii) Bogie Hearth Furnace, (iii) Billet Transfer Facilities and Utility Services consisting of (a) Oxygen Supply System, (b) Compressed air Supply System and is a part of the total TIRFAC Center as shown in the Drawing No. PMC/TIRFAC/01 Rev R-0. The Tenderers are required to bid for those facilities only which are covered under this tender enquiry.

9.2.2 The work shall be carried out by the successful Tenderer on a complete turnkey basis for the above mentioned facilities with his own supervisors, masons, technicians, tools and tackles, erection material and equipment. All the work shall be carried out by skilled work men holding valid licenses.
9.2.3 This specification covers, design, engineering, preparation of drawings, manufacturing, assembly, factory testing, Packing, forwarding, transit insurance, delivery at site, unloading, storage, insurance during storage, in plant transportation to erection site, related site work, erection, testing and commissioning of all electrical equipment / system as required for the facilities mentioned above.

9.2.4 All the Mechanical, Electrical, Refractory, Instrumentation and other equipment shall be designed as per applicable standard and codes of practice furnished by Indian Standards Institutions (BIS); Indian Electricity Rules & statutory requirements of Central Government and State Govt. and where relevant IS is not available, IEC standards shall be followed.

9.2.5 The tenderer shall study the details and technical particulars given in this Tech. Specifications of Mechanical, Electrical, refractory, Instrumentation and other equipment and satisfy himself regarding the suitability of the equipment offered for the required duty / application. The tenderer shall stand guarantee for the satisfactory and reliable control operation and performance of the equipment offered by him.

9.2.6 The cost of commissioning spares required for successful erection, testing and commissioning shall be built up in the quotation submitted by the tenderer.

9.2.7 The Tenderer shall be responsible for total detailed engineering including preparation of specification drawings, civil assignment drawings, working drawings, equipment layouts, erection drawings etc.

9.2.8 The tenderer shall visit site and satisfy himself in all respects with site conditions before quoting. After acceptance of tender, no claim for extra payment submitted by the tenderer on ground of any local working or site conditions will be considered.

9.2.9 Tenderer shall obtain approval / clearance from electrical Inspector / factory inspector, statutory governing bodies etc. for installation / erection work done by him.

9.2.10 Any additional equipment / item which might have not been specifically mentioned in this specification but is necessary for achieving specified performance; control & completeness of the system shall be provided by the successful tenderer without any extra cost and within the time schedule.

9.2.11 Damage to painting suffered during transit / erection shall be made good by the contractor free of cost before its equipment is accepted by the Purchaser / Client.

9.2.12 The contractor shall keep his working site / work place neat & clean after completion of the site work; the contractor shall clean the site thoroughly and shall not leave any debris, unwanted material etc at site.

9.2.13 Tenderer shall also quote and recommend a list of operation and maintenance spares for all equipment for 2 years considering the fact that the subject plant will not be in continuous production but shall be in operation for about 10 in every month, for investigations. This plant is being set up basically for Demonstration Purpose and hence minimum spares shall be recommended/offered.

9.2.14 Construction power and water required at site shall be arranged by the successful Tenderer at his own cost.

9.2.15 Material brought to the site shall not be removed from the site without the written consent of the purchaser.

9.2.16 The tenderer on award of contract shall submit a detailed program of work and Bar chart within two weeks so that the same shall be approved by the purchaser.
9.2.17 First fill of for all consumables (lubricants, spares etc) and any additional amount required up to the handing over of the plant is included in the tenderer’s scope.

9.2.18 During detailed engineering the successful tenderer shall furnish civil assignment drawings indicating the embedded walls floor inserts, dimensions of the concrete channels for cables for enabling preparation of proper civil drawings. Pipe trenches, equipment foundation details shall also be indicated in the civil assignment drawings with static and dynamic loading of the equipment and rotating machines.

9.2.19 Sundry civil works (e.g. chipping, drilling holes on walls, digging etc) required for tenderer’s own erection job is included in this specification as tenderer’s scope.

9.2.20 If water, due to seepage or rain water present in the earth pit / pipe trench / cable trench etc, it should be pumped out at no extra cost by the successful tenderer till handing over of the plant.

9.2.21 Make of equipment / components shall be from “Preferred Make List” only. This shall be adopted for each type of equipment / component considering plant standardization and also inventory control.

9.2.22 The successful Tenderer shall take full responsibility for completion of the job and putting the system in smooth operation in an integrated manner. The Purchaser shall work at site in close interaction / coordination with other agencies responsible for other facilities.

9.2.23 Exclusions list and deviations, if any, from the Tender specifications, shall be put at in the offer and with reasons; otherwise the same may not be considered.

9.2.24 The tenderer shall manufacture and supply all the material only after submitting the drawings and specifications of the material and after due approval from the Purchaser.

10.0 INSPECTION, TESTING, ERECTION, COMMISSIONING & P.G.TEST

10.1 Inspection & Testing

- Prior to inspection the Tenderer shall provide OMTC for all the bought out items. Items shall be dispatched only after test certificates are accepted and dispatch clearance is given by the purchaser.
- Testing shall be in accordance with IS codes
- The equipment shall be inspected at the supplier’s or in sub-supplier’s works by the purchaser’s representative prior to dispatch and also at intervals deemed fit by the customer. However, the Tenderer has to give the inspection call at least one week in advance together with their Internal inspection reports, test certificates, drawings, documents and catalogues etc.
- Leakage testing of the pipelines shall be done at 1.5 time the rated pressure and leakage shall not exceed 2% in 1 (one) hour.
- All electrical equipment / items, e.g. motors, MCC panels; control desks, push button stations; cable etc shall be fully tested in accordance with the relevant IS / IEC
- Routine tests as per relevant standards shall be carried out on all the electrical items at manufacturer’s works in presence of the purchaser / his representative. Thereafter test certificate shall be submitted.
Test certificates for motor, air circuit breakers, contactors etc of similar rating as demanded by the purchaser shall be submitted.

All Electrical equipment / items shall be dispatched only after test certificates are accepted and dispatch clearance is given by the purchaser.

Any defects observed during the inspection and testing, the materials will be summarily rejected. The Tenderer shall offer for re-inspection of items after replacement / repair at his own cost. Cost of re-inspection will be borne by the Tenderer.

All the tool / equipment required for testing shall be arranged by the Tenderer at his own cost.

### 10.2 Erection, Testing, Commissioning & PG Test

- The Tenderer shall be fully responsible for the satisfactory erection / installation, testing and commissioning of all the equipment and material under his scope including pipe erection, insulation of pipes etc. The installation shall be carried out in line with the Central Pollution Control Board guidelines and Statutory Authority Rules and Indian Standards.

- The Tenderer shall provide all skilled, semi-skilled or unskilled labour, riggers, certified welders, pipe fitters, as well as erection and testing engineers.

- The electrical installation shall be carried out by an electrical contractor holding a valid license issued by the State government for carrying out the installation work of the voltage classes involved under the direct supervision of and by a person holding valid certificate of competency for the same voltage classes recognized by the state government.

- The work shall be executed in a professional workmanship manner.

- Nuts & bolts, gaskets, grease, lubricating oil, packing material, brass shims and other hardware necessary for erection work shall be included in Contractor’s scope.

- All consumable items like, gases for welding, welding electrodes etc shall be provided by the Contractor at his cost.

- All tools, tackle, instruments, material handling equipment for transportation, mobile cranes, welding sets, gas cutting equipment, crimping tool, drill machines, level gauges etc shall be arranged by the Contractor for carrying out erection commissioning work.

- All tests shall be carried out at site by the Contractor using his own testing instruments having valid calibration certificates as well as qualified testing personnel.

- Supply and erection of first aid boxes, fire extinguishers, sand buckets, shock treatment charts, rubber mats, danger boards etc. as per electricity rules and as per requirement for the premises of the plant shall be provided by the contractor.

- It is the total responsibility of the Contractor to ensure completeness of the job as per specification on turn key basis for supply, erection, testing & commissioning and handing over the plant to the full satisfaction of the Purchaser.
10.3 PG Test

- PAT will be done after completion of the complete erection and testing of the furnace.
- FAT will be done after completion of running of the furnace for one month.
- In both PAT and FAT performance of the furnace will be assessed by measuring the following parameters in the test billet.
  (i) Average discharge temperature of the billet.
  (ii) Top to bottom temperature difference
  (iii) Fuel consumption
  (iv) Scale loss
- Production rate of 5.0 TPH shall be maintained for the entire charge in the furnace before the test billet.

11.0 GUARANTEE

11.1 The Tenderer shall guarantee that the equipment will give performance as required by this specification considering the furnace design details as per UNDP/GEF Project (Steel) Basic Design parameters.

11.2 The various components of the furnace and its auxiliaries shall be guaranteed against any defect in design, material and workmanship for a minimum period of 12 months from the date of commissioning.

12.0 INFORMATION SUBMISSION AND APPROVALS FROM PURCHASER

12.1 Information / data / drawings to be submitted along with the tender

(i) General arrangement drawing for the Walking Hearth Furnace and Bogie Hearth Furnace showing plan elevation and sections highlighting furnace profile, key dimensions, location of burners and length of each zone etc. both in plan and elevation. Typical design details of different areas shall be submitted.

(ii) General description of furnace design, P&I diagrams, heat mass & energy balance.

(iii) Performance test values

(iv) Complete detailed specifications of the various items offered, including makes, along with catalogues, literature etc. (Preferred makes for major items of equipment are given in Annexure–IIb).

(v) Single line diagram for electrical loads.

(vi) Requirement of various utilities.

(vii) Items-wise weight of:
  - Structural Steel
  - Castings
  - Mechanicals
  - Refractories & Insulation materials; and
Piping & supports
Chimney
(viii) List of imported items, if any,
(ix) Delivery period and time schedule of completion of work.
(x) List of references of similar work executed by the supplier elsewhere during the last 5 years including details thereof.

12.2 Price:

For design & engineering

FOR destination price for supply of equipment (item-wise) in the following break-up inclusive of packing and forwarding charges.

i. Structural Steel parts for furnace proper
ii. Castings
iii. Mechanical Equipment
iv. Combustion Equipment
v. Refractories & insulation materials for furnace, duct & chimney
vi. Piping, piping insulation & supports
vii. Flue duct structuralss
viii. Chimney
ix. Instrumentation & controls
x. Electrical Equipment
xi. Pneumatic Equipment
xii. Hydraulic Equipment such as power pack unit and cylinders.
xiii. Air drier system for instrumentation if any.

FOR price for supply of spare parts for 2 years normal operation basis including list of the items and quantity offered.

(xii) Duties, taxes, freight and insurance charges shall be shown separately.
(xiii) Charges for erection & commissioning including supervision.
(xiv) Other terms & conditions, if any

12.3 Information / data / drgs / documents to be submitted for reference / approval in requisite copies after award of contract

- Supply of Three (3) sets of specification sheets, layout of plant & equipment, GA drawings separately for furnaces, flue duct and chimney showing plan, elevation and sections, P&I diagram, Piping GA Drawings, Electrical Control Schemes/single line diagram etc. for approval of purchaser/consultants within 2 weeks of the placement of order.

- Supply of three (3) sets of foundation plans showing outline with load data, Bolt dimensions, pocket size and depth, grouting etc. to the purchaser within 2 weeks of approval of GA and other drawings by the purchaser or their authorized representative to enable purchaser’s civil engineer to prepare the civil design and construction drawings.
• Supply of four (4) sets of manuals for the installation, commissioning, operation and maintenance of the furnace at least two (2) months before the commissioning.

• Single line diagrams with component ratings, settings range etc.

• Motor Data Sheet

• Equipment load data

• Circuit diagrams

• Certified general arrangement drgs of electrical equipment / panels with dimensions weight, sectional views, foundation / mounting details etc.

• Bill of quantities with type ratings, make, technical data, etc

• Electrical equipment layout drgs inside DG Room, ECR and shop floor

• Interconnection & terminal plan drgs

• Equipment test certificates

• O & M manuals

• Any other information / drgs / documents as felt necessary by the purchaser for the project.

• List of imported items if any

12.4 As Built Drawings

(i) Upon installation & commissioning, supplier shall incorporate revisions / modification, if any done at site in the reproducible or tracings and submit the same as “As Built Drawings” for purchaser’s record in two sets of all the final drawings / documentation etc.

(ii) After correction, final CD (Soft Copy) shall be submitted (2-sets) for as built drawings.

13.0 TRAINING

The supplier will provide training to operating personnel of purchaser for 4 weeks at site in operation & maintenance of the complete plant, free of cost. In case, the training is desired in a running plant of similar type prior to commissioning of this unit, the terms & conditions of the same should be clearly illustrated in the offer.

14.0 DELIVERY

The Walking hearth type billet reheating furnace and bogie hearth furnace etc. with all its auxiliary equipment and facilities and other scope of work as per scope of this specification shall be delivered, Erected, Commissioned and Handed over to purchaser within a period of 8 (eight) months from the date of issue of letter of intent (LOI). Tenderer shall note that the delivery period is the essence of the contract. Necessary bar chart showing the schedule of activities shall be furnished in the offer.
15.0 TENDER SUBMISSION

The offer shall be sent at the address given below: -

PROJECT MANAGEMENT CELL
UNDP/GEF Project (Steel)
Ministry of Steel, Government of India,
301-306, Aurobindo Place, Hauz Khas, (3<sup>rd</sup> floor)
New Delhi – 110016, India.
Tel : +91-11-26534397, 26862478
Fax : +91-11-26517568
E-Mail : srrm_india@undpgefsteel.org

Kind Attn:

Shri S Dewan, National Project Director
Shri G Mishra, Manager (Projects & Contracts)
Annexure-IIa

SYSTEM DESCRIPTION AND SCOPE OF WORK OF ELECTRICS

1.0 SYSTEM DESCRIPTION AND SCOPE OF WORK

1.1 This is a general description for the tenderer to understand location, operation & scope of work relating electrics.

1.2 The normal power supply at 415V AC, 3-ϕ, 50 HZ, 4-Wire shall be made available from a Main Diesel Generator Set of rating 500 KVA approximately, located in a room (S.No 6 of the Equipment layout) in the plant for plant operation.

1.3 There shall be one electrical control room (ECR) adjacent to D.G. room. PMCC housing feeders and controls for different drives shall be located inside air-conditioned ECR. The lighting panel and other related electrical panels (E.M. brake panels; rotor resistance boxes etc if any depending upon final drive list) shall also be located inside ECR.

1.4 The Isolation and protection cabinets pertaining to Roller table motors shall be located in shop floor. These cabinets can be wall mounted.

1.5 Operators control desks shall be located in front of the furnace roller tables.

1.6 The Tenderer’s scope includes design, manufacture, supply, unloading & storage, erection and commissioning of Electrical drives for the furnaces with associated control panels, instrument panels, control desks, etc for the Walking Hearth Furnace, Bogie Hearth Furnace, Compressor Station of the TIRFAC Hardware Centre.

1.7 The successful Tenderer shall provide lightning protection in chimney as per I.S.

1.8 The scope of supply and work for electrics shall include but not limited to the following:

   (i) The scope of work shall consist of design, engineering, manufacture, inspection, assembly, shop testing, painting, supply and storage at site, erection, testing & commissioning of all electrical equipment for the Walking Hearth Furnace, Bogie Hearth Furnace, Compressor Station of the TIRFAC Hardware Centre.

   (ii) Drive motors

   (iii) Earthing material & material for lightning protection up to common earthing ring.

   (iv) Supply of commissioning spares

   (v) Insulating mats in front and back of all panels, first aid boxes, danger boards, shock treatment charts etc.

   (vi) Statutory authority approval / clearance for the electrical installation.

   (vii) The tenderer shall include in his scope of supply all components, material, accessories, and sundry item required to render the installation / erection fully operative in all respects even though every individual item may not have been detailed out explicitly in the T.S.
2.0 BASIC DESIGN DATA

Following basic design data shall be considered for design / selection of the electrical equipment & components:

2.1 Site ambient condition

(a) Max ambient air temperature : 50°C (indoor equipment) and 55°C (outdoor equipment)

(b) Minimum ambient air temperature : 1°C

(c) Relative humidity : 100%

(Relative humidity and max. temp will not occur simultaneously)

(d) Climate : tropical

(e) Mean sea level :

2.2 Standard Voltage levels

(a) L.T. Power supply : 415 VAC ± 10%, 3-phase, 50 HZ ± 3%

(Power supply from D.G. set)

(b) Combined voltage & frequency variation: ± 10%

2.3 Short circuit level (3-phase symmetrical)

(a) At 415 V switch gear : 50 KA for 1 sec

2.4 Control voltage : 240 V AC + 10% obtained through control transformer

3.0 SECIFICATIONS OF L.T AC Motors

3.1 General purpose L.T. AC motors

1. The motors shall comply with latest revision of relevant standards of BIS where relevant I.S. is not available, IEC standards shall be followed.

2. Motors shall generally be continuous duty (SI) unless otherwise as required for the driven mechanism. Continuous motor rating shall be at least 15% above the load demand of driven equipment at design point after considering all transmission losses and all applicable derating factors because of specified ambient temperature, voltage & frequency variations, specific site & derating conditions; specific control requirement like frequency converter etc.

The motor rating shall be such that it is not overloaded at any operating point of driven equipment from zero to full load.

3. All AC induction motors shall generally be squirrel cage, totally enclosed fan cooled (TEFC) design, having method of cooling IC 0141 as per IS 6362 with the fan directing air over motor frame.

4. All AC induction motors shall fully conform to IS-325 for all essential design, construction and test features.
5. The motors shall have standardized dimensions and ratings strictly conforming to IS-1231 for foot mounted; IS-2223 for flange-mounted and IS 2254 for vertical shaft motors.

6. The winding of general purpose squirrel cage induction motor shall have class ‘B’ insulation with temperature rise restricted to $70^\circ$C over an ambient air temp of $50^\circ$C; measured by resistance method.

   For higher ambient temperature the maximum temperature rise of the winding shall be correspondingly reduced.

7. The degree of enclosure protection for the motors conform to IS–4691.
   - All general purpose squirrel cage induction motors shall have including the terminal box shall have minimum degree of protection IP-54.
   - Crane duty motors shall have IP-55 enclosure
   - Weather proof enclosure having degree of protection IPW-55 shall be adopted for outdoor duty motors.

8. All motors up to 75 KW rating shall be subjected to at least four (4) cold starts or three (3) hot starts.
   - For motors above 75 Kw rating cold starts and hot starts shall be limited to three (3) and two (2) respectively.
   - For each cold start, motor shall cool down to the ambient temperature and for hot start, the temperature of the motor shall be considered at its rated load operating temperature.

9. All general purpose squirrel cage motors shall be designed for D.O.L. starting at full voltage with starting current generally not exceeding six (6) times the rated full load current.

10. The motors shall be generally designed for a minimum pull out torque of 200% rated torque at full voltage. Higher pull out torque shall be provided where specifically required.

11. The rating of the motors selected shall be based on the class of duty and the load imposed by the driven equipment. The starting torque, pull up torque and pull out torque of the motor shall be properly co-ordinated with the requirement of driven equipment to ensure smooth and rapid starting and steady operation.

12. All motors shall be designed to withstand 120% of rated speed for two (2) minutes without any mechanical damage in either direction of rotation.

13. Motors shall be capable of starting and accelerating to full speed at full load (including loaded equipment) at 80% of nominal voltage at motor terminals.

14. All motors rotors shall be dynamically balanced to comply with the requirement of IS: 12075 including the amplitude of vibration specified there in.

15. The motor feet shall be integrally cast with the stator and shall be of such designs as to prevent breakage or other failures due to vibrations normally, encountered in steel plants.

16. The noise level of motors shall not exceed the limits specified in IS : 12065
17. Ball and roller bearings used for the motors shall be provided with proper greasing facilities for motors of frame sizes 250 and above.

18. Motors with frame sizes 280 and above shall be provided with space heaters where specified.

19. The motor body shall have two separate earthing terminals for earthing in compliance with Indian electricity Rules.

20. Motors shall be provided with lifting hooks plugs for frame size 100 and above.

21. Motor terminal Box
   - The Motor terminal box and terminals shall be adequately sized properly insulated and suitable to receive PVC heavy duty armoured cables with aluminium conductor.
   - Adequate clearance shall be provided between live terminals and the cover.
   - The T.B. shall be rotatable in steps of 90 degrees to allow cable entry from any direction.
   - All six (6) terminals shall be brought out to the T.B. for the stator winding and star or delta connections formed with links.

22. All motors shall be provided with a rating plate as per I.S. 325

23. Painting: Motors shall receive anti-rust paint before coating with two coats of final paint (approved by customer)

24. Tests
   - All Motors shall be fully tested in accordance with the relevant IS / IEC.
   - Routine tests as per relevant standard shall be carried out on all motors at manufacturer’s works in presence of the purchaser / his representative and thereafter test certificate shall be submitted.
   - Type test certificates for motors of similar ratings shall be submitted for the motors offered.
   - Motors shall be dispatched only after test certificates are accepted by the purchaser.

3.2 Individually driven AC roller table duty motors

The primary function of a roller table is to accelerate, convey and decelerate to stop / reversing the material (billet) as quickly and as frequently as required.

Standard general purposes squirrel cage A.C. induction motors will not be suitable for roller table application. Torque motors are best suited for such application.

- Construction of torque motors is similar to standard general purposes A.C. motors but with modified mechanical / electrical design.
- Speed / torque characteristics is linear and there is no unstable region in the characteristic.
- Motors shall be designed for high starts / stops / reversals by d.c. injection breaking and inching duty.
- Machine shall be capable of developing high dynamic constant (B-value) to take care of its inertia and that of connected load.
- Designed for high stalling time as per application requirement.
- Motor shall be designed for $50^\circ$C ambient temperature.
- Insulation class of motor shall be class ‘F’ with temperature rise limited to class ‘B’, that is, $70^\circ$C over $50^\circ$C measured by resistance method.
- Motor shall be equipped with 3-embedded thermistors in its hot spot region to provide protection against over-heating.
- Suitable for D.O.L. starting shall be designed to take care of severe mechanical / electrical shock loads.
- Motor frame shall be made of high quality cast iron / S.G. iron and Motor shaft shall be made out of high tensile strength steel.
- Other design criteria shall be as per standard A.C. squirrel cage motors given above.
- Flange / foot mounted heavy duty geared motors (AGMA class-III) suitable for roller table duty application shall be provided considering the duty cycle.

4.0 SPECIFICATIONS FOR MOTOR CONTROL CENTRE (MCC)

4.1 Constructional Features
- MCC shall be single front, totally enclosed, compartmentalized, CRCA sheet steel fabricated, self standing, floor mounted with incomer feeder as draw out type and outgoing feeders as non-draw out type.
- MCC shall be dust, damp and vermin proof and enclosure conforming to IP-54 class.
- Sheet steel enclosures of MCC shall be CRCA sheet steel of thickness 2 mm minimum.
- Cable entry shall be from bottom. MCC bottom shall have detachable CRCA sheet steel gland plate of thickness not less than 3.0 mm.
- MCC shall have concealed hinges, feeder compartments shall be totally closed from all sides with a door on front side.
- Factory built assembly in multi-tier, fully compartmentalized design, each compartment dedicated to a feeder.
- Independent vertical cable alley in each panel with a minimum clear width of about 250 mm covered by hinged door.
- Minimum operating height of devices on panel to be 350 mm and maximum operating height to be 1900 mm.
- Each section of MCC to be provided with removable lifting facility.
- MCC shall be provided with base channel of 75 mm x 40 mm (ISMC – 75)
- Module doors and cable alley doors to open in opposite direction.
● To ensure good earth continuity all bolted joints shall be provided with tooth / spring washers. MCC shall have two separate earthing studs for earthing as per IE rules.

● Clear, legible identification labels shall be provided for all power, control & signaling devices, panel number, module / compartment number, mechanism / system description on the compartment door etc.

● Compartment door shall be interlocked with the main power isolating device with provision for defeating it by authorized person. Power circuit isolation device shall have facility for pad locking in the ‘OFF’ position with door closed.

● MCC should be easily extendable at both ends with multi tier compartmental arrangement.

4.2 Feeder arrangement, wiring etc

Incomer Feeder:

Outgoing Motor Feeder: Outgoing motor feeders shall be provided with following components:

a) Moulded case circuit breaker provided with requisite protections as per application.

b) Power Purchaser AC3 duty / AC4 duty as applicable (Reversible contactors with mechanical & electrical interlocking for reversible drives)

c) Hand reset separately mounted over load relays with built in single phasing prevention facility and resetting push button. For motors of 110 KW rating and above (if any) comprehensive motor protection relay (MPR) shall be provided.

d) C.T. operated ammeter for motors of 15 KW & above

e) ON (Fwd & Rev), OFF, O/L trip indication lamps. O/L trip indication will be taken from an auxiliary Purchaser operated by O/L relay.

f) 2 – pole MCB (9 KA S.C. capacity) in each motor feeder control circuit

g) Test P.B. for testing power contactor with main circuit disconnected

h) A set of auxiliary contactors for sequencing, interlocking and annunciation

i) Other equipment / components as required according to final approved circuit diagram.

   ● Thermal O/L relay / magnetic O/L relay with time delay features shall be provided in the power circuit as applicable.

   ● All equipment and components shall be neatly arranged and shall be easily accessible for easy operation and maintenance.

   ● MCCB, Purchaser and O/L relays shall be selected to ensure type – C co-ordination a per IEC – 292 – 1A (Type – 2 as per IEC – 947 – 1).

   ● Control transformer shall be rated for full capacity of MCC including spare feeders and auxiliary contactors plus 20% additional spare capacity.

   ● The control transformer shall be double wound dry type, self ventilated with tapping ± 2.5% and ± 5% at primary side.

   ● All MCCB feeders (Non-motor feeders) shall be provided with ‘ON’ and ‘OFF’ indicating lamp and CT operated ammeter with 4-positions ASS as required.
● Internal control circuit wiring shall be with 1.1 grade, single core PVC cables with copper conductor of 2.5 sq. mm.

● Control wiring shall be laid in plastic troughs with covers or neatly bunched and cleated with no joints.

● Not more than two connections shall be done at any one terminal. All wiring shall be accessible from front.

● 20% spare terminals shall be provided in each compartment.

● All spare contacts shall be wired up to the terminal block.

● 20% spare feeders (equipped) and fully wired up shall be provided in MCCs.

4.3 Major components in MCC

(i) Motor Protection Moulded case circuit breakers

● Shall be complete with thermal and magnetic release selected so as to allow trouble free starting of the motor.

● Features to minimise the let-through energy ($I^2t$) in the event of short circuit on load side.

● Motor protection MCCB selection suitable for fault level at the point of application. No fuse back up is acceptable.

● Provided with minimum 1 No + 1 NC aux. Contacts for indication purpose.

● MCCB shall be provided with shunt trip coil wherever required (particularly in case of torque motors) for tripping of MCCB due to the tripping command given by motor protection thermister relay.

● Ratings of MCCB selected shall be at least 125% of the full load current of the motor.

(ii) Magnetic Contactors

● Shall conform to IEC-947-4 (1990)

● Shall be capable of interrupting ten times the rated current for rated sizes up to 100 A and eight times the rated current for larger sizes.

● Suitable to carry the prospective short circuit currents without damage of injurious heating till the protective device operates.

● Coil shall be designed for A.C. No economy resistors to be used.

● Insulation of coils shall be Class `E` or better.

● Shall pick up positively at voltage between 85% to 110% of rated value.

● Drop out shall be between 75% and 40% of rated value.

● All contactors shall be AC3 duty for all continuously rated drives. The contactor rating (AC3 duty) shall be minimum 125% of rated FLC of the motor and 150% minimum in case of fan motor and other high inertia loads as well for inching duty and frequently reversing duty.

● AC4 rating contactors shall be selected for inching and plugging operation of the drive.
- DC Purchasers shall be provided with adequately rated magnetic blow out coil for effective arc quenching.
- For reversible drives, mechanical as well as electrically interlocked contactors shall be used.

(iii) Overload relay
- Shall be triple pole, ambient temperature compensated, inverse time log, hand reset type microprocessor based with adjustable setting.
- The Thermal O/L relay shall conform to IEC – 292 - 1
- At least one make and one break contact (1 No + 1 NC) with ratings same as for auxiliary contact of the contactors.
- Shall have built in single phasing protection unit.
- The relay shall be able to withstand prospective short circuit current without damage or injurious heating till the motor protection MCCB clears the S.C. fault.
- Auto tripping shall be indicated on the MCC.
- The O/L relay range shall be 70% to 120% of circuit full load current. No nuisance tripping during starting shall be ensured.
- Heavy duty C.T. operated O/L relays shall be provided for drive having high starting time like fans and other high inertia drive as required.

(iv) Thermister Protection
- Thermisters to be provided for roller table motors through 3 PTC thermisters embedded in the stator in its hot spot region to provide protection against overheating.
- Thermisters generally conform to BS-4999 (Part–72). The reference temperature shall be chosen in accordance with the class of insulation used for the motor winding, taking into account adequate safety margin.
- PTC with sharp knee characteristics and high signal to noise ratio.
- NC contact of thermisters signal processing unit which opens in case of temp. rise in motor winding shall be utilized in motor starter circuits.

(vii) Current transformers
- Bar type primaries and 5A (max) secondaries with thermal and dynamic ratings corresponding to the units, with which they are used.
- Measuring CT accuracy class 1.0
- Protective CT accuracy class 10 P 10
- Conform to IS: 2705 – 1992

(viii) Voltmeters and Ammeters
- Shall be digital with LED
4.4 Specifications for Power circuit isolation & protection cabinets

- Isolation & protection cabinets are required for individually driven roller table motors. One cabinet for one group of roller table motors shall be considered.
- Each of these cabinets shall have one incomer isolator MCCB for the group and outgoing feeder MCCB for each motor in the group and thermister protection relay one for each motor with red indicating lamps for motor tripping.
- These cabinets shall be fabricated from CRCA sheet steel of thickness not less than 2 mm with bottom detachable gland plate of thickness 3 mm minimum.
- The enclosure shall be dust & vermin proof, well gasketted with hinged door in the front; class of protection IP – 54

4.5 Control desks

- The control desk shall be located in front of walking hearth furnace for control operation of roller tables, billet pusher / billet extractor etc.
- The control desk shall house master controllers, indicating lamps, selector switches and other control devices as per operational requirement.
- The control desk shall be CRCA sheet steel (of thickness 3.00 mm minimum) free standing, floor mounted, dust & vermin proof with high quality non-deteriorating rubber gasketting degree of protection IP-54; assembled on base channel of IS MC 100, with removable lifting arrangement, with cable entry from bottom having 3 mm thick gland plate (Undrilled & removable) having facility to keep the hinged top cover of the desk in open position for maintenance and inspection and with interior painted white to enhance illumination
- Control desk shall have slanted top, bolted covers on the sides & bottom concealed hinged door on the rear and front be provided.
- Internal wiring of the desk by 1.1 KV grade PVC insulated, single core copper flexible wire of cross section 2.5 sq. mm.

4.6 Local control push button stations

- One (1) set wall mounted push button stations as required shall be considered and supplied by the tenderer for local operation of some of the drives / system.
• The Push button station shall be made of CRCA sheet steel of thickness not less than 2.00 mm and bottom gland plate of thickness not less than 3.0 mm.

• The degree of protection for enclosure shall be IP – 55

• P.B. station shall be weather, dust & vermin proof, wall mounted type provided with requisite number of push buttons, switches, indicating lamps, meters and other control devices required as per operational requirement.

• It will have hinged lockable front door.

• “Start” PB shall be green colour shrouded type with 1 No + 1 NC contacts (minimum) or as per final circuit diagram.

• “Stop” PB shall be red colour, un-shrouded type with 1 No + 1 NC contact (Minimum) or as per final circuit diagram.

• “Emergency Stop” P.B. shall be red colour mushroom headed lockable type (Press to lock and turn to release type)

• Wiring with extra flexible wires and the wire size shall be 2.5 sq. mm copper, PVC insulated.

• 20% spare terminals shall be provided

5.0 EARTHING

(a) Entire system shall be earthed in accordance with the provision of the relevant IEC recommendations / IS code of practice IS 3043 and Indian Electricity Rules; so that the values of the step potential and contact potentials in case of faults are kept within safe permissible limits.

(b) Parts of all electrical equipment and machinery (not intended to be alive) shall have two separate and distinct earth connections each to conform to the stipulation of the Indian Electricity Rules and apparatus rated for 240V and below may have single earth connection.

(c) All shops / buildings / Electrical rooms / Generator room / pump houses etc shall be provided with a ring main earthing system each. Individual ring main earthing system shall again be interconnected as a network.

(d) For the purpose of dimensioning the earthing lines / conductors, the duration of the earth fault current shall be taken as 0.3 seconds.

(e) For different floors in electrical rooms / generator room / pump house etc, localized ground mats shall be formed and connected to the main ground earthing ring through vertical risers.

(h) The minimum size of galvanized MS Flat / wire for earthing of various equipment / system shall be as follows:

(i) Earthing leads connected between main earth ring and the earth electrodes: 75 x 10 mm

(ii) Localised ground mat laid inside / around the premises: 65 x 8 mm

(iii) Earth continuity conductor connection (vertical riser) between main earthing ring & localized ground mat: 65 x 8 mm
(iv) MCC / LT switch boards / MLDB: 50 x 6 mm
(v) Motors from 45 kw and below 90 kw: 40 x 6 mm
(vi) Motors from 15 kw and below 45 kw: 25 x 6 mm
(vii) Motors from 3.7 kw up to 11 kw: 16 Sq.mm stranded G.I.wire
(viii) Motors below 3.7 kw / local push button stations / junction boxes / limit switches etc: 6 sq.mm stranded wire
(ix) Control desk / cabinets / distribution board / instrument panels / relay panel etc: 25 x 3 mm flat
(x) Isolator / MCCB and socket outlets above 16 A up to 100 A: 50 sq.mm stranded G.I. wire
(xi) Earthing Electrode: Buried earthing electrode shall be G.I. pipe 50 mm dia and 4 mm thick and 3 M long in one piece provided with water holes.
(xii) Separate earthing system shall be provided for the electronic equipment and system as recommended by the manufacturer.

6.0 LIGHTNING PROTECTION SYSTEM

All buildings and plant structures vulnerable to lightning strokes owing to their height or exposed situations shall be protected against atmospheric flash overs and lightning strokes. Stipulations of IS : 2309 shall be followed

Size of conductors for lightning protection shall be as follows:

(i) Horizontal air termination : 40 x 6 mm G.I. Flat
(ii) Vertical air termination : 45 mm G.I round bar 1 M long
(iii) Down conductor above ground : 40 mm x 6 G.I. Flat

- Horizontal air termination conductor shall be cleated on the steel structure at suitable intervals. The down conductors shall also be created at regular intervals.
- Each down conductor shall be connected to riser through testing point. The height of the test point from ground shall not be more than 1.5 meter.
**PREFERRED MAKES OF EQUIPMENT**

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<th>S.No</th>
<th>Material</th>
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GENERAL CONDITIONS OF CONTRACT FOR GOODS

1. LEGAL STATUS
The Contractor shall be considered as having the legal status of an independent contractor vis-à-vis PMC. The Contractor's personnel and sub-contractors shall not be considered in any respect as being the employees or agents of PMC or Ministry of Steel (MOS) / UNDP. The Project Management Cell will not be a principal employer in any of the circumstances.

2. SOURCE OF INSTRUCTIONS
The Contractor shall neither seek nor accept instructions from any authority external to PMC in connection with the performance of its services under this Contract. The Contractor shall refrain from any action which may adversely affect PMC or the MOS/UNDP and shall fulfill its commitments with the fullest regard to the interests of PMC.

3. CONTRACTOR'S RESPONSIBILITY FOR EMPLOYEES
The Contractor shall be responsible for the professional and technical competence of its employees and will select, for work under this Contract, reliable individuals who will perform effectively in the implementation of this Contract, respect the local customs, and conform to a high standard of moral and ethical conduct. Contractors will follow labour law including Employee Provident Fund etc of the laborers. He will be liable to pay the Provident Fund to the labourer(s) engaged by him and will defend himself or deposit in case of Provident Fund demand by the concerned authority. In case of default, PMC will keep certain amount as an advance guarantee for the Employees Provident Fund payment or if the Project Management Cell is forced to pay under the given circumstances.

4. ACCEPTANCE OF THE PURCHASE ORDER
This Purchase Order may only be accepted by the Supplier's signing and returning an acknowledgement copy of it or by timely delivery of the goods in accordance with the terms of this Purchase Order, as herein specified. Acceptance of this Purchase Order shall effect a contract between the Parties under which the rights and obligations of the Parties shall be governed solely by the terms and conditions of this Purchase Order, including these General Conditions. No additional or inconsistent provisions proposed by the Supplier shall bind PMC unless agreed to in writing by a duly authorized official of PMC.

5. TERMS OF PAYMENT
   I. 10 % of the contract price within 30 days of signing of contract against Bank Guarantee
   II. 80 % of the contract price after delivery, commissioning and testing of goods
   III. 10 % after the completion of warranty period or against submission of Bank Guarantee for warranty period

6. PAYMENT
6.1 PMC shall, on fulfillment of the Delivery Terms, unless otherwise provided in this Purchase Order, make payment within 30 days of receipt of the Supplier's invoice for the goods and copies of the shipping documents specified in this Purchase Order.
6.2 Payment against the invoice referred to above will reflect any discount shown under the payment terms of this Purchase Order, provided payment is made within the period required by such payment terms.

6.3 Unless authorized by PMC, the Supplier shall submit one invoice in respect of this Purchase Order, and such invoice must indicate the Purchase Order's identification number.

6.4 The prices shown in this Purchase Order may not be increased except by express written agreement of PMC.

6.5 In case erection/commissioning gets delayed for reasons beyond contractors control, PMC shall release 50% payment of invoice amount along with 100% taxes and duties.

7. **SUBMISSION OF SCHEDULE OF ACTIVITIES**

The contractor shall submit the detailed schedule of activities for completion of the assignment within 2 weeks from the date of LOI to PMC for approval.

8. **FITNESS OF GOODS/PACKAGING**

The Supplier warrants that the goods, including packaging, conform to the specifications for the goods ordered under this Purchase Order and are fit for the purposes for which such goods are ordinarily used and for purposes expressly made known to the Supplier by PMC, and are free from defects in workmanship and materials. The Supplier also warrants that the goods are contained or packaged adequately to protect the goods.

9. **INSPECTION**

9.1 PMC will depute designated personnel/authorized inspection agencies for inspecting plant and equipment in supplier premises both for indigenous and imported goods.

9.2 Alternatively, PMC shall have a reasonable time after delivery of the goods to inspect them and to reject and refuse acceptance of goods not conforming to this Purchase Order; payment for goods pursuant to this Purchase Order shall not be deemed an acceptance of the goods.

9.3 Inspection prior to shipment does not relieve the Supplier from any of its contractual obligations.

10. **LIQUIDATED DAMAGES**

If the supplier fails to deliver any or all of the good or to perform the services within the period(s) specified in the contract, the purchaser shall, with prejudice to its other remedies in the contract, deduct from the contract price, as liquidated damages. Liquidated damages shall not exceed 0.5% per week, and the maximum shall not exceed 5% of the contract price. Once the maximum is reached, the purchaser may consider termination of the contract.

11. **SUB-CONTRACTING**

In the event the Contractor requires the services of sub-contractors, the Contractor shall obtain the prior written approval and clearance of PMC for all sub-contractors. The approval of PMC of a sub-contractor shall not relieve the Contractor of any of its obligations under this Contract. The terms of any sub-contract shall be subject to and conform with the provisions of this Contract.
12. **OFFICIALS NOT TO BENEFIT**

The Contractor warrants that no official of PMC has received or will be offered by the Contractor any direct or indirect benefit arising from this Contract or the award thereof. The Contractor agrees that breach of this provision is a breach of an essential term of this Contract.

13. **INDEMNIFICATION**

The Contractor shall indemnify, hold and save harmless, and defend, at its own expense, PMC, its officials, agents, and employees from and against all suits, claims, demands, and liability of any nature or kind, including their costs and expenses, arising out of acts or omissions of the Contractor, or the Contractor's employees, officers, agents or sub-contractors, in the performance of this Contract. This provision shall extend, inter alia, to claims and liability in the nature of workmen's compensation, products liability and liability arising out of the use of patented inventions or devices, copyrighted material or other intellectual property by the Contractor, its employees, officers, agents, or sub-contractors. The obligations under this Article do not lapse upon termination of this Contract.

14. **ENCUMBRANCES/LIENS**

The Contractor shall not cause or permit any lien, attachment or other encumbrance by any person to be placed on file or to remain on file in any public office or on file with PMC against any money due or to become due for any work done or materials furnished under this Contract, or by reason of any other claim or demand against the Contractor.

15. **WARRANTY**

Warranty on all goods supplied under the contract shall remain valid for 12 months from the date of supply of equipment or 18 months from the date of issue of order which ever is later. The purchaser shall promptly notify the Supplier in writing of any claims arising under this warranty. Upon receipt of such notice, the Supplier shall, within the specified period repair or replace the defective goods or parts thereof, without costs to the purchaser.

16. **INSTALLATION AND COMMISSIONING**

The supplier shall depute experienced and qualified person for carrying out installation and commissioning of all plant and equipment at our site. The period of commissioning will be mutually decided at the time finalization of contract depending upon the nature of plant and equipment.

17. **SPARES**

The supplier shall carry sufficient inventories to assure ex stock supply of consumable spares for the goods supplied for a period of 2 years from the date of supply. The item of spare along with the quantity will be mutually agreed at time of finalization of contract. The supplier will forward all relevant drawings and documents to enable PMC to get these spare manufactured subsequently after the 2 years period are over.
18. CONSUMABLES
The contractor will include supply of consumables for running the plant (except the input material), if so desired in the tender enquiry the detailed item along with the cost will be finalized at the time of placement of order.

19. MANUALS / DRAWINGS
The supplier will submit 3 sets of manuals including drawings to enable smooth operation of plant and equipment covered under the supply.

20. INTELLECTUAL PROPERTY INFRINGEMENT
The Supplier warrants that the use or supply to PMC of the goods sold under this Purchase Order does not infringe any patent, design, trade-name or trade-mark. In addition, the Supplier shall, pursuant to this warranty, indemnify, defend and hold PMC harmless from any actions or claims brought against PMC pertaining to the alleged infringement of a patent, design, trade-name or trade-mark arising in connection with the goods sold under this Purchase Order.

21. RIGHTS OF PMC
In case of failure by the Supplier to fulfil its obligations under the terms and conditions of this Purchase Order, including but not limited to failure to obtain necessary export licences, or to make delivery of all or part of the goods by the agreed delivery date or dates, PMC may, after giving the Supplier reasonable notice to perform and without prejudice to any other rights or remedies, exercise one or more of the following rights:
   a) Procure all or part of the goods from other sources, in which event PMC may hold the Supplier responsible for any excess cost occasioned thereby.
   b) Refuse to accept delivery of all or part of the goods.
   c) Cancel this Purchase Order without any liability for termination charges or any other liability of any kind to PMC.

22. TERMINATION
PMC, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Supplier, may terminate this Contract in whole or in part:
   (a) If the Supplier fails to deliver any or all of the Goods within any extension thereof granted by the Purchaser.
   (b) If the supplier fails to perform any other obligation (s) under the Contracts

23. PACKING & MARKING
   (a) All items shall be suitably packed for transit by rail / road.
   (b) Each package shall be suitably marked with identification markings to enable satisfactory reference to corresponding invoice and supply order. In addition the outer dimensions volume and gross weight of each package shall be stenciled legibly in metric units.
   (c) A packing note detailing the stores supply order no. and item no. is to be enclosed with each package showing order no. of total packing and contents of each package, etc. shall be made available to the consignee viz National Project Coordinator

24. SALES TAX
   (a) The prices indicated are inclusive of sales tax
(b) The present rate of sales tax is __________%

(c) While claiming sales tax please furnish the following certificates:

“Certified that the goods on which sales tax has been charged have not been exempted under the Sales Tax Act or the rules made thereunder and the charge on account of sales tax on those goods are correct under the provision of that act or the rules made thereunder”

“Certified further we (or our Branch) or Agent are registered as dealers in the State ______________________ (address) under Registration no. ________ for purpose of Sales Tax”

The stores should be on no account be dispatched / delivered without getting the same inspected and passed by the Inspecting Officer stipulated in the contracts. The contractor alongwith packing note of stores inform the consignee immediately after dispatch of store by rail / road.

25. INSURANCE

25.1 The goods supplied under the contract shall be fully insured against loss or damage incidental to manufacture, transportation storage and delivery. The insurance shall be in an amount equal to 100% of the CIF value of the goods from warehouse to warehouse on all risk cover basis.

25.2 The purchaser will not separately have transit insurance and the supplier will be responsible until the entire stores contracted for arrive in good condition at destination. In case the contractor chooses to insure the goods he should notify the consignee in writing while forwarding the dispatch document (such as inspection notes etc.) about the time limit within which the claims for shortages in transit should be notified by the consignee. The insurance amount will be reimbursed by PMC.

25.3 The certificate of testing and guarantee of quality be also forwarded alongwith the material

26. ASSIGNMENT AND INSOLVENCY

26.1 The Supplier shall not, except after obtaining the written consent of PMC, assign, transfer, pledge or make other disposition of this Purchase Order, or any part thereof, or any of the Supplier's rights or obligations under this Purchase Order.

26.2 Should the Supplier become insolvent or should control of the Supplier change by virtue of insolvency, PMC may, without prejudice to any other rights or remedies, immediately terminate this Purchase Order by giving the Supplier written notice of termination.

27. COPYRIGHT, PATENTS AND OTHER PROPRIETARY RIGHTS

PMC shall be entitled to all intellectual property and other proprietary rights including but not limited to patents, copyrights, and trademarks, with regard to products, or documents and other materials which bear a direct relation to or are produced or prepared or collected in consequence of or in the course of the execution of this Contract. At the PMC's request, the Contractor shall take all necessary steps, execute all necessary documents and generally assist in securing such proprietary rights and transferring them to PMC in compliance with the requirements of the applicable law.
28. **USE OF NAME, EMBLEM OR OFFICIAL SEAL OF UNDP OR THE UNITED NATIONS**

The Contractor shall not advertise or otherwise make public the fact that it is a Contractor with PMC, nor shall the Contractor, in any manner whatsoever use the name, emblem or official seal of PMC or MOS, or any abbreviation of the name of PMC or the MOS in connection with its business or otherwise.

29. **CONFIDENTIAL NATURE OF DOCUMENTS AND INFORMATION**

29.1 All maps, drawings, photographs, plans, reports, recommendations, estimates, documents and all other data compiled by or received by the Contractor under this Contract shall be the property of PMC, shall be treated as confidential and shall be delivered only to PMC authorized officials on completion of work under this Contract.

29.2 The Contractor may not communicate at any time to any other person, Government or authority external to PMC, any information known to it by reason of its association with PMC which has not been made public except with the authorization of PMC; nor shall the Contractor at any time use such information to private advantage. These obligations do not lapse upon termination of this Contract.

30. **FORCE MAJEURE; OTHER CHANGES IN CONDITIONS**

30.1 Force majeure, as used in this Article, means acts of God, war (whether declared or not), invasion, revolution, insurrection, or other acts of a similar nature or force which are beyond the control of the Parties.

30.2 In the event of and as soon as possible after the occurrence of any cause constituting force majeure, the Contractor shall give notice and full particulars in writing to PMC, of such occurrence or change if the Contractor is thereby rendered unable, wholly or in part, to perform its obligations and meet its responsibilities under this Contract. The Contractor shall also notify PMC of any other changes in conditions or the occurrence of any event which interferes or threatens to interfere with its performance of this Contract. The notice shall include steps proposed by the Contractor to be taken including any reasonable alternative means for performance that is not prevented by force majeure. On receipt of the notice required under this Article, PMC shall take such action as, in its sole discretion, it considers to be appropriate or necessary in the circumstances, including the granting to the Contractor of a reasonable extension of time in which to perform its obligations under this Contract.

30.3 If the Contractor is rendered permanently unable, wholly, or in part, by reason of force majeure to perform its obligations and meet its responsibilities under this Contract, PMC shall have the right to suspend or terminate this Contract on the same terms and conditions as are provided for in Article 15, "Termination", except that the period of notice shall be seven (7) days instead of thirty (30) days.

31. **PROHIBITION ON ADVERTISING**

The Supplier shall not advertise or otherwise make public that it is furnishing goods or services to Ministry of Steel or UNDP without specific permission from MOS or UNDP as the case may be.

32. **CHILD LABOUR**

The Supplier represents and warrants that neither it nor any of its affiliates is engaged in any practice inconsistent with the rights set forth in the Convention on the Rights of the Child, including Article 32 of Constitution of India thereof, which, inter-alia, requires that a child
shall be protected from performing any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development.

Any breach of this representation and warranty shall entitle PMC to terminate this Purchase Order immediately upon notice to the Supplier, without any liability for termination charges or any other liability of any kind of PMC.

33. **SETTLEMENT OF DISPUTES**

33.1 **Amicable Settlement**

The Parties shall use their best efforts to settle amicably any dispute, controversy or claim arising out of, or relating to this Contract or the breach, termination or invalidity thereof. Where the parties wish to seek such an amicable settlement through conciliation, the conciliation shall take place in accordance with the procedure as may be agreed between the parties.

33.2 **Arbitration**

If at any time, any question, dispute or difference whatsoever shall arise between the purchaser / owner and the supplier upon or in relation to, or in connection with the contract (except as to any matter the decision on which is specifically provided for) the same may be referred to the sole arbitration of the Secretary, Ministry of Steel, Government of India or a person appointed by him. It will not be objected if the arbitrator is a Government servant that he had dealt with matters to which contract related or that in course of duties as a Government servant he has expressed views on all or any other matters in dispute or difference. The award of the arbitrator shall be final and binding on the parties to the contract.

Subject to as aforesaid the Arbitration and Conciliation Act 1996 of India and the rules thereunder and any other statutory modification thereof for the time being shall be deemed to apply to the arbitration proceedings under this clause. The Arbitrator shall have the power to extend with the consent of the purchaser and supplier, the time for making and publishing the award. The venue of arbitration shall be the place as the purchaser in his absolute discretion may determine.

34. **PRIVILEGES AND IMMUNITIES**

Nothing in or related to these General Terms and Conditions or this Purchase Order shall be deemed a waiver of any of the privileges and immunities of the United Nations, including its subsidiary organs.

35. **OBSERVANCE OF THE LAW**

The Contractor / supplier shall comply with all laws, ordinances, rules, and regulations bearing upon the performance of its obligations under the terms of this Contract.

36. **AUTHORITY TO MODIFY**

No modification or change in this Contract, no waiver of any of its provisions or any additional contractual relationship of any kind with the Contractor shall be valid and enforceable against PMC unless provided by an amendment to this Contract signed by the authorized official of PMC.

37. **JURISDICTION**

All disputes will be subject to the territorial jurisdiction of Delhi including arbitration.