VOLUME – IA
Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Tender Specification No.: BHEL: PSSR: SCT: 2195

TENDER SPECIFICATION

BHEL: PSSR: SCT: 2195

TECHNICAL CONDITONS OF THE CONTRACT

FOR

Erection, Testing & Commissioning of Control and Instrumentation (C&I) works including Handling of materials at site BHEL stores / storage yard, transporting to site of erection and supply & application of final painting, for Unit-2 and identified BOP areas at 2 X 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS, Tamil Nadu.

BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)

Power Sector – Southern Region

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PROJECT INFORMATION

INTRODUCTION

ENNORE SEZ SUPERCRITICAL TPS UNITS- 1 & 2 [2 x 660 MW] is being set up by **TAMILNADU GENERATION AND DISTRIBUTION CORPORATION** at a site in Vayalur Village Near Ennore Port, Tamil Nadu, India. Plant will be set up in existing Ash Dyke of NCTPS by reclamation of some portion of the Ash Dyke. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

APPROACH TO SITE

The proposed plant will be located at Ash dyke of North Chennai Thermal Power, approximately 35 km from Chennai, in the state of Tamil Nadu, India. The site is occupying a coastal site near the village of Vayalur. The nearest commercial airport is at Chennai located at a distance of 60 km from the project site.

Nearest Airport – Chennai

Nearest Airstrip – Chennai

Nearest Seaport – Ennore

A. Project Information & Location

- **Project Title:** Ennore SEZ project of 2 x 660 MW Coal Based Super Critical Thermal Power Project at ash dyke of NCTPS
- **Plant Capacity:** 1320 MW (2 units of 660 MW each)
- **Type of Project:** Green field
- **Owner:** Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
- Owner Consultant: DESEIN, DELHI
- **Plant site location:** Ash dyke of North Chennai Thermal Power Station (NCTPS)
- **Location co-ordinates:** 80o 18’ E to 80o 19’ E Longitude

  13o 17’ N to 13o 18’ N Latitude
- **Nearest Village:** Vayalur
- **Nearest Town & City:** Chennai (35 Km)
- **State Capital:** Chennai (35 Km)
- **Nearest Railway Station:** Athipattu Pudunagar (~5 Km) on Chennai-Vijayawada line

- **Nearest Airport:** Chennai (~60 Km)
- **Nearest Seaport:** Ennore (~5 Km)
- **Nearest Road access:** All weather road from Pattamandri on the Thiruvottiyur – Ponneri district highway.

B. Meteorological Condition

- **Climate:** Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
- **Site Elevation:** (+) 10.0 m above Mean Sea Level
- **Ambient Temperature:** a. Maximum 32.0 Deg. C
  b. Minimum 24 Deg. C
  c. Design ambient temperature 35 Deg. C
- **Relative Humidity:** a. Maximum 100%
  b. Minimum 36%
  c. Design 75%
- **Annual Rainfall**: a. Maximum 2540 mm
  b. Average 1600 mm
  c. Minimum 1175 mm
- **Wind Data:** a. Basic wind speed at 10m height: 50 m/sec
  b. Average: 11.8 kmph (Average)
  c. Wind pressure As per IS: 875 Part III (Latest Edition)
- **Seismic Zone:** Zone III as per IS: 1893-2002
- **Design ambient temperature:** 50 Deg. C (For electrical Equipments)

VOLUME IA PART I CHAPTER II
SCOPE OF WORKS

1.2.1. The scope of works covers C&I works of Unit 2 and identified BOP areas of 2x660 MW ENNORE SEZ SUPERCRITICAL TPS as mentioned below, including supply of labour, tools and plants. The Scope of the works is indicative but not limited to the given below.
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.2.2. The scope of works broadly consists of C&I works pertaining to the following:

- ❖ Unit 2 (Main Plant)
- ❖ Identified BOP areas as per BOQ including:
  - o ETP and STP
  - o EPABX System
  - o Simulator
  - o MIS/LAN
  - o CCTV, Intrusion Detection System and Access Control System
  - o Fire Fighting/Protection System as per BOQ including:
    - ▪ Medium and High Velocity Water Spray System and Fire Detection & Alarm System of Unit 2 and identified BOP areas, as per the BOQ, including areas of CHP System and AHP System pertaining to Unit-2, other non-plant buildings, etc.

Note: The above provided list is indicative only. Any other area not mentioned above, but required for completion of the scope of the works, shall be deemed to have been included in the bidder scope under this contract. Such work will be executed under this contract by bidder as per the direction of Engineer in charge.

1.2.3. **SCOPE OF C&I WORKS IN GENERAL:**

1.2.3.1. **Preassembly, Erection, Testing and Commissioning, Trial operation and reliability operation of the following (as applicable):**

(i) All types of Field Instruments (Gauges/Switches/Transmitters/Elements) like Temperature, Pressure, Flow (Paddle Wheel/DP/Ultrasonic, etc types of Local/Remote), Level, Density instruments (Local & remote) and special instruments like PD type Mass Flowmeters, etc.

(ii) All Analyzers-Oxygen, HF, Flue Gas (SOX/NOX/CO), Mercury, NH3, CO, SOX, NOX & Opacity.

(iii) Vibration Monitoring System, Turbine Supervising Control and Monitoring System. Please refer the detailed scope of works in relevant chapters. and commissioning (assistance)

(iv) SWAS system with analyzers i.e. (Conductivity, Sodium, Iron, Silica, Chloride, Turbidity, Dissolved Oxygen, pH)

(v) Microprocessor based flame scanner system, H.E.A Exciter system, Acoustic Steam Leak Detector, Coal Bunker Level Monitor system

(vi) Large Video Screen System

(vii) UPS & Battery System of different kVA & AH ratings

(viii) HART Management System under the Supervision of OEM

(ix) Wireless communication, Station LAN, OPC Connectivity to all PLC (or) off site DCS wherever required

(x) All type of Control Room instruments like Recorders, Indicators, Microprocessor based panels, DCS system and its accessories like system panels, Network Panels, Network Enclosures, PCs, Laptops, Printers, Computer, Furniture etc.

(xi) All type of Pneumatic Power Cylinders, Controllers, Limit Switches, etc.

(xii) All type of Hardware like impulse pipes, Cable trays & tray supports, instrument airline, etc.

(xiii) Master Clock system

(xiv) Control & Instrumentation works associated with Water Systems.

(xv) UPS, ACDB, Battery Chargers, Battery Health Monitoring panels, DCDB, Power Distribution Boards etc.

(xvi) All type of Local/Remote control panels and LGB, LIE, LIR, Network Enclosures, Junction Boxes, Pushbutton stations.

(xvii) Control & Instrumentation works associated with Fire Protection System (FPS) like Remote IO, Fire Alarm Panels, Repeater Panels, FDA/FPS panels, Fire Detectors, Modules, Power, Control & OLHS/LHS cables, OFC & Splicing, Instruments, etc.

(xviii) Laying, termination & testing of all types of power/control/instrumentation cables/Special Cables, etc.

(xix) Laying & Splicing of Optical Fiber Communication Cables with/without conduits

(xx) Any other items that have not been specifically indicated, but required for completing installation of C&I Package.

(xxi) Control & Instrumentation works of BOP Systems like Simulator, EPABX System, Plant Security System, MIS, PADO etc.

(xxii) Calibration of instruments at site with the contractor's own calibration and testing equipment under the supervision of BHEL/Customer Engineers.

1.2.3.2. **Testing & Commissioning of the following - Erected by other contractors (includes cabling, tubing, removing, calibrating, testing, etc as required)**

(i) All types of Pneumatic/ Motor Operated Valves/ Actuators/ Power Cylinders/ Controllers and Relief Valves.

(ii) Temperature Elements of all the HT Drives

(iii) Bidirectional Drives and Unidirectional Drives (HT/LT Drives) & Limit Switches

(iv) Removal, Calibration and re-fixing of the instruments in various systems as specified in the BOQ

(v) Dosing Systems (Oxygen, NaOH, Ammonia & Hydrazine)

(vi) Demonstration of the Mechanical and C&I Lab instruments. This includes transportation of the instruments from the stores to the place of erection, installing / setting up the instruments and commissioning / providing assistance to the OEM for demonstrating the instruments to the customer.

(vii) Calibration of instruments at site with the contractor's own calibration and testing equipment under the supervision of BHEL/Customer Engineers.

1.2.3.3. **Others:**

(i) Final Painting including supply of paints, as detailed in scope of respective item/ equipment.

(ii) Supply of all consumables required for installation as detailed elsewhere in the specification.

(iii) Embossing Permanent nomenclature on equipment erected/ Trays/ panels/ wherever required as per site requirement.

(iv) Necessary arrangements for Protecting and safe guarding the Erected equipment from any damages and pilferages.

(v) Fabrication and installation of steel supports wherever required.

1.2.3.4. **Note:**

(i) If any peripheral C&I item associated with the above said main equipment which was not erected by other contractor but it is required for complete commissioning shall be erected and commissioned by the contractor within the quoted rate.

(ii) Contractor shall have valid license to carry out the work indicated in the BOQ.

(iii) BHEL will provide OEM's technical support for commissioning of various proprietary type special instruments/systems like Vibration Monitoring System, SWAS, Flue Gas Analyzers, Master Clock System, Coal Bunker Level Monitoring

System, LVS System, HART Management System, Furnace Flame Viewing System, EPBAX, C&I Lab, Wireless Communication, Station LAN, OPC Connectivity to all PLC (as applicable), etc. The contractor shall carry out the works as per instructions of BHEL/ OEM's Engineer

1.2.4. **EXCLUSIONS:**

The following are specific exclusions from this work.

a. Erection of Dampers, Pneumatic/Motor Operated Valves, Electrical Actuators, HT/LT Drives

b. Attachment welding of thermocouple pads, Flow Nozzle, Orifice Plates and Control Valves

c. Root Valves on the instruments tapping points

d. Seal Welding on temperature stub on piping before hydro test.

e. Removal of seal welding on temperature stub on piping after successful completion of hydro test. Height of the temp stub to be maintained as per piping drawing.

Note:

The above exclusions shall not be concluded as final. They are meant for general guidelines. BHEL reserves the right to include or exclude any item which is required for completing the job as per rates indicated in rate schedule. Contractor shall carry out all such jobs as per the instructions of BHEL Site Engineer.

1.2.5. The scope of work covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre- assembly, calibration, checking, erection, testing and commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, PVC sleeves for wire marking, lugs (specific sizes), specific type of fasteners, paints and its consumables, T & P, Material handling equipment's, Testing instruments, deployment of skilled / unskilled manpower, engineers / supervisors, returning of un-used materials / items to BHEL stores.

1.2.6. The scope of specification covers the material receipt from BHEL stores, transportation to erection site, installation, testing and commissioning of the equipment, hardware, software communication along with accessories as detailed in Bill of Materials.

1.2.7. If any item or equipment not covered but requires to be erected / commissioned, the same shall be carried out by the contractor. Equivalent unit rate for those item or equipment shall be considered wherever possible from the BOM.

1.2.8. **Note:** FOR BOQ & FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT CHAPTERS IN THIS BOOK

Note: Detailed BOM systems wise and BHEL unit wise with detailed specification of various equipment's and items are given in the VOLUME- IA PART-I CHAPTER-IX. The rate schedule is the summary of BOM i.e. consolidated list of BOM. Contractor shall go through the detailed BOM and specification before quoting his price.

VOLUME-IA PART-I CHAPTER-III
FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL
(SCOPE MATRIX)

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.1.	**ESTABLISHMENT**			
1.3.1.1.1.	FOR CONSTRUCTION PURPOSE:			
A.	Open space for office	Yes		As provided by TANGEDCO
B.	Open space for storage	Yes		
C.	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	At Bidder's Own Cost
D.	Bidder's all office equipments, office / store / canteen consumables		Yes	
E.	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
F.	Firefighting equipments like buckets, extinguishers etc.		Yes	
G.	Fencing of storage area, office, canteen, labour hutment, etc. of the bidder,		Yes	
1.3.1.1.2.	**FOR LIVING PURPOSES OF THE BIDDER**			
A.	Open space		Yes	At Bidder's Own Cost
B.	Living accommodation		Yes	
1.3.1.2.	**ELECTRICITY**			
1.3.1.2.1.	Electricity For construction purposes (to be specified whether chargeable or free)	YES		On chargeable basis to bidder as per Prevailing rate of TANGEDCO

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
(a)	Single point source (In general) For detail, refer clause no. 1.3.4.1	Yes		On chargeable basis to bidder as per Prevailing rate of TANGEDCO
(b)	Further distribution for the work to be done which include supply of materials and execution		Yes	At Bidder's Own Cost
1.3.1.2.2.	Electricity for the office, stores, canteen etc. of the bidder which include:		Yes	At Bidder's Own Cost
(a)	Distribution from single point including supply of materials and service		Yes	At Bidder's Own Cost
(b)	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	At Bidder's Own Cost Calibration certificate to be provided
(c)	Duties and deposits including statutory clearances for the above		Yes	At Bidder's Own Cost
(d)	Living facilities for office use including charges		Yes	At Bidder's Own Cost
(e)	Demobilization of the facilities after completion of works		Yes	At Bidder's Own Cost
1.3.1.2.3.	Electricity for living accommodation of the bidder's staff, engineers, supervisors, labour hutment etc. on the above lines.		Yes	At Bidder's Own Cost
1.3.1.3.	**WATER SUPPLY**			
1.3.1.3.1.	For construction purposes:	Yes		Chargeable to bidder as per prevailing rate of TANGEDCO

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
(a)	Making the water available at single point	Yes		Chargeable to bidder as per prevailing rate of TANGEDCO
(b)	Further distribution as per the requirement of work including supply of materials and execution		Yes	At Bidder's Own Cost
1.3.1.3.2.	Water supply for bidder's office, stores, canteen etc.		Yes	
1.3.1.4.	**LIGHTING**			
1.3.1.4.1.	For construction work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site / area		Yes	At Bidder's Own Cost
1.3.1.4.2.	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5.	**COMMUNICATION FACILITIES for site operations of the bidder**	-		
1.3.1.5.1.	Telephone, Fax, internet, intranet, email etc		Yes	At Bidder's Own Cost
1.3.1.6.	**COMPRESSED AIR SUPPLY**			
1.3.1.6.1.	Supply of Compressor and all other equipments required for compressor & compressed air system including pipes, valves, storage systems etc		Yes	
1.3.1.6.2.	Installation of above system and operation & maintenance of the same		Yes	
1.3.1.6.3.	Supply of the all the consumables for the above system during the contract period		Yes	

Sl.No	Description PART II	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2.	**ERECTION FACILITIES**			
1.3.2.1.	**Engineering works for construction**			
1.3.2.1.1.	Providing the construction drawings for all the equipment covered under this scope	Yes		
1.3.2.1.2.	Drawings for construction methods		Yes	In consultation with BHEL
1.3.2.1.3.	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	In consultation with BHEL
1.3.2.1.4.	Shipping lists etc for reference and planning the activities	Yes	Yes	In consultation with BHEL
1.3.2.1.5.	Preparation of site construction schedules and other input requirements		Yes	In consultation with BHEL
1.3.2.1.6.	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.7.	Weekly construction schedules based on Sl No 1.3.2.1.5		Yes	
1.3.2.1.8.	Daily construction / work plan based on Sl No 1.3.2.1.7		Yes	For daily monitoring meeting at site
1.3.2.1.9.	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	
1.3.2.1.10.	Preparation of preassembly bay		Yes	
1.3.2.1.11.	Laying of racks for gantry crane if provided by BHEL or brought by the contractor/bidder themselves			Not Applicable

1.3.3. **OPEN SPACE:**

1.3.3.1. Open space will be provided to the bidder free of cost as provided by TANGEDCO. Availability of land within plant boundary is very limited and the contractor has to plan

and use the existing land considering the use of land by other Civil /mechanical/ electrical contractors and the storage of plant machineries and materials. The existing land shall be shared by all erections agencies. Land will be allocated with certain time frame and to the extent available/ considered necessary, and will be reviewed by BHEL depending upon the area availability. Area within plant premises for batching plant, fabrication yard, office, storage area etc. for construction purpose shall be provided as per availability free of cost. The contractor will be responsible for handing back all lands, as handed over to him by BHEL.

1.3.3.2. Contractor has to make his own arrangements for labour colony at their own cost. The contractor to construct labour colony/ hutment as per his requirements after obtaining approval of formalities from statutory body. The contractor shall provide adequate water arrangement for drinking/washing/bathing with required toilets, drainage system, lighting facilities etc. in labour colony at their own cost. Suitable paved area to be provided in the labour colony at their own cost.

1.3.4. **ELECTRICITY**:

1.3.4.1. In general, Construction power will be provided to the contractor on prevailing rates of TANGEDCO on **chargeable basis** at one single point WITHIN THE PLANT AREA by BHEL. The contractor to Provide necessary energy meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. However, based on request of Contractor and requirement of project, BHEL Site in charge, at his discretion, may provide construction power at multiple point (as close to work area as possible), for smooth execution of the work at site. If, BHEL provides electricity at more than one point (as close to work area as possible), it will be responsibility of the contractor to provide all the support necessary for enabling BHEL for extending such provision to contractor. However, the Construction power provided to the contractor shall be on chargeable basis at prevailing rates of TANGEDCO. The contractor has to Provide necessary meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/ LCB etc. Any dispute, BHEL engineer's decision shall be final and binding on contractor.

1.3.4.2. Construction power prevailing charges are as below,

The present LT tariff VI rate of TANGEDCO is

a) Consumption charges at Rs.12.25 per unit
b) Maximum demand (MD) charges as applicable per month
c) Low Power Factor (LPF) charges
d) Electricity Tax on total amount
e) Any other miscellaneous charges charged by M/s TANGEDCO pertaining to construction power supply.

Note - The TANGEDCO tariff and tax may vary from time to time and the same is applicable for the bidder.

1.3.4.3. Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.

1.3.4.4. Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards contractor's office shed also all such expenditure shall be borne by the contractor.

1.3.4.5. Provision for distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

1.3.4.6. BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.

1.3.4.7. Contractor has to make their own arrangements for electricity requirement for labour colony at his own cost.

1.3.4.8. As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

1.3.5. **WATER:**

1.3.5.1. Water (Raw water) required for construction purposes will be provided at one single point WITHIN THE PLANT AREA on chargeable basis to contractor at the prevailing rates of TANGEDCO. The contractor to Provide necessary meter for measuring the water consumption. The required pumps & accessories, pipes for drawing water from the given point and further distribution will be arranged by the contractor at their cost to go on without interruptions.

1.3.5.2. Successful Bidder to make his own arrangements for drinking water / water for sanitation for their labourer & staff at bidders cost.

1.3.5.3. The water charges may vary from time to time as per TANGEDCO/ Metro conditions. However, the prevailing water charge is Rs 191.00 per Kilo litres and may be liable to changes. Any dispute regarding consumption, the BHEL engineer decision will be final. The TANGEDCO tariff and tax may vary from time to time and the same is applicable for the successful bidder.

1.3.5.4. Incase non-availability of water or the TANGEDCO is not able to supply the water, the contractor shall make his own arrangements of water suitable for construction purpose to have uninterrupted work. No separate payment shall be made for any

contingency arrangement made by contractor, due to delay / failure for providing water supply. Contractor has to make his own arrangements for their water requirement for their labour colony at their own cost**.**

1.3.6. **CONSUMABLE**

1.3.6.1. Such of those consumables as indicated as consumables provided by BHEL, alone will be provided to the contractor by BHEL free of charge for erection activities. Other required consumables like electrodes, all gases, solvent cement for CPVC Pipes and other materials for this scope of work are to be arranged by the contractor at their cost.

1.3.6.2. All the required electrodes (in contractor's scope) as approved by BHEL shall be arranged by contractor at their cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement regarding, suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc.

1.3.6.3. All electrodes including stainless steel electrodes required for shall be arranged by the contractor at their cost. The bidder shall use the BHEL/Customer approved quality welding electrodes only.

1.3.6.4. The contractor shall provide within finally accepted price / rates, all consumables (excepting those indicated in BHEL scope) like welding electrodes (including alloy steel and stainless steel), filler wires, TIG filler wires (over & above as supplied by the unit along with the plant materials, which will be given free of cost to bidder), gases (inert, welding, cutting), soldering material, dye penetrants, radiography films, etc. Other erection consumables such as tapes, jointing compound (As applicable), grease, mobile oil, M-seal, Araldite, petrol, solvent cement for CPVC Pipes(as applicable), CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, packers (<10mm), wooden planks, scaffolding materials hardware items etc. required for temporary works such as supports, scaffoldings are to be arranged by the contractor. Sealing compounds, gaskets, gland packing, wooden/concrete sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by the contractor.

1.3.6.5. P91/T91, P92/T92 electrodes (as applicable) shall be supplied by BHEL free of cost as supplied by BHEL Manufacturing Units. Required quantity as arrived at by calculation / standards will only be supplied. It would be the contractors' responsibility to account for the consumption of these filler wires. Additional consumption beyond standard / calculated quantity will be at cost recovery basis only unless and otherwise accounted for. Surplus quantity of TIG filler wire, if any, shall be properly stored and returned to BHEL stores.All the shims, gaskets and

packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.

1.3.6.6. All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.

1.3.6.7. In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same and recover the cost incurred for the same along with BHEL overheads from the contractor. The entire cost towards this along with standard BHEL overhead shall be deducted from the contractor's immediate due bills.

1.3.7. **LIGHTING FACILITY (with ELCB):**

1.3.7.1. Adequate lighting facilities such as flood lamps, hand lamps and area lighting shall be arranged by the contractor at the site of construction, and contractor's material storage area etc. at his cost.

1.3.8. **MATERIAL SUPPLY:**

1.3.8.1. BHEL will supply the materials/equipment indicated in the BOQ/weight schedule from their respective manufacturing units which are to be erected/incorporated in the permanent system.

1.3.9. **POSSESSION OF GENERATORS:**

1.3.9.1. As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, suitable extension of time, if found necessary shall only be given and contractor is not entitled for any compensation. It shall be the responsibility of the contractor to provide, and maintain the complete installation on the load side of the supply with due regard to safety requirements at site. It shall be responsibility of the contractor to have at least 2 Nos. of diesel operated generator sets to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by the contractor. This may also be noted while quoting. No separate payment shall be made for this contingency.

1.3.10. **GASES**

1.3.10.1. All the required gases like Oxygen / Acetylene / argon /Nitrogen required for work shall be supplied by the Contractor at their cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non

availability of gases cannot be considered as reason for not attaining the required progress.

1.3.10.2. BHEL reserves the right to reject the use of any gas in case required purity is not maintained.

1.3.10.3. The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

1.3.10.4. The contractor shall ensure safe keeping of the inflammable cylinder at a separate place away from normal habit with proper security etc.

1.3.11. **ELECTRODES SUPPLY AND STORAGE**

1.3.11.1. The bidder shall use the BHEL / Customer approved quality welding electrodes only.

1.3.11.2. It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement, regarding suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc.

1.3.11.3. Shortage of any of the electrodes or the equivalent suggested by BHEL shall not be quoted as reason for deficiency in progress or for additional rate. Contractor shall submit weekly/ fortnightly/ monthly statement/ report regarding consumption and available stock of all types of electrodes for avoiding stoppage of work on consumable scarcity.

1.3.11.4. Storage of electrodes shall be done in an air conditioned / controlled humidity room as per requirement, at their own cost by the contractor.

1.3.11.5. All low hydrogen electrodes shall be baked / dried in the electrode drying oven (range 375 deg. C - 425 deg. C) to the temperature and period specified by the BHEL Engineer before they are used in erection work and each welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by contractor at their cost.

1.3.11.6. In case of improper arrangement of procurement of above electrodes BHEL reserves the right to procure the same from any source and recover the cost from the contractor's first subsequent bills at market value plus departmental charges of BHEL communicated from time to time. Postponement of such recovery is not permitted.

1.3.11.7. BHEL reserves the right to reject the use of any electrodes at any stage, if found defective because of bad quality, improper storage, date expiry, unapproved type of

electrodes etc. It shall be the responsibility of the contractor to replace at their cost without loss of time.

1.3.12. **ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS]**

1.3.12.1. Contractor has to provide at BHEL office, minimum two (02) computers and printers along with refilling of cartridges whenever required (along with one operator per PC) for online material management, reporting of daily progress, billing and other similar activities, within the quoted rate. BHEL reserves the right to make alternative arrangement and recover the cost incurred for the same along with BHEL overheads from the contractor, if the required nos of PCs are not deployed by the contractor.

1.3.13. **OTHER FACILITIES**

1.3.13.1. Adequate waterless urinals [at least 2 nos per level] shall be arranged by the contractor within quoted rates, at site of construction at different level and different areas like boiler structure, with proper disposal arrangement.

1.3.14. **MATERIALS /CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR AT THEIR COST FOR ERECTION AND COMMISSIONING OF RESPECTIVE EQUIPMENTS/ITEMS.**

1.3.14.1. All welding electrodes, filler wires, gases shall be arranged by the contractor at their cost.

1.3.14.2. Supply of paints, Ferrules, lugs for sizes up to 2.5 sq mm shall be in the scope of the contractor within the quoted rate.

1.3.14.3. **Other items:**

(i) Provision for Temporary scaffoldings

(ii) Insulation tapes

(iii) Paints required for primer coating & final coating and for protective coating. Paint of approved colour, consumables like thinner brushes, emery paper etc.,

(iv) Solder wire (Lead 60/40)

(v) Protocol / calibration report sheets as per BHEL format

(vi) Panel / JB sealing compound material (for cable entry from bottom / top of panel)

(vii) Materials required for cable dressing (GI / Aluminium Flats, PVC Cable ties, etc)

(viii) Anchor fasteners for wall mounted cable trays & JBs wherever required.

(ix) PVC wire marker sleeves and tag plates

(x) Lugs of size 2.5 sq.mm and below

(xi) Ferrules

(xii) "U" clamps with nuts and washers for impulse pipes and GI pipe clamping.

(xiii) Tag Plats-Al/Fiberglass/Stainless Steel

(xiv) Insulation Tapes

(xv) Teflon Tap for GI pipe coupling

(xvi) Fastener for mounting JB, Local PB boxes and earthing flats.

(xvii) PVC cable tie, Aluminium or GI strips and fasteners for clamping of cables and other dressing materials required for cable dressing, grommet sleeves for cables.

1.3.15. **TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS**

1.3.15.1. **CABLE LUGS:**

Type	Solderless Crimping Type
Material	Copper/ Aluminium
Whether Tinning required (for copper cable lugs)	Yes
Thickness of Tinning	10 Microns
Applicable Standard for LT cables	IS:8309

1.3.15.2. **FERRULES**

Colour of Ferrules	Yellow/White
Colour of Engraving	Black

1.3.15.3. **TAGS:**

Material	Al/Fiberglass/Stainless Steel
Markings	Engraving/Embossing/Printing

1.3.16. **CONTRACTOR'S OBLIGATION ON COMPLETION:**

1.3.16.1. On completion of work, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instructions of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

VOLUME-IA PART – I CHAPTER – IV
T&PS AND MMEs TO BE DEPLOYED BY CONTRACTOR

1.4.1. Major T&P and testing equipment given in the below list is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity/ numbers as mutually agreed at site for major T&Ps, have to be adhered to.

1.4.2. The following minimum Instruments / T&P shall be arranged by contractor in sufficient number as required to carry out the job simultaneously in more than one area. The list is tentative and not exhaustive.

A. List of Recommended Instruments for Erection, Testing & Commissioning.

Sl.No.	Description	Quantity
01	Dead Weight tester rated 600 kg/sq.cm with weights & test gauges facility.	As required
02	Oil temperature bath suitable to calibrate upto 400˚ C, 600˚ C+20%	As required
03	Furnace range 600 Deg C	As required
04	Standard Pressure Gauges as below :	As required
	0 to 1 kg/Sq.cm	As required
	0 to 5/6 kg/Sq.cm	As required
	0 to 10 kg/Sq.cm	As required
	0 to 16 kg/Sq.cm	As required
	0 to 25 kg/Sq.cm	As required
	0 to 60 kg/Sq.cm	As required
	0 to 100 kg/Sq.cm	As required
	0 to 250 kg/Sq.cm	As required
05	Standard Temperature Gauges as below :	As required
	0 to 100 Deg C	As required
	0 to 200 Deg C	As required
	0 to 600 Deg C	As required
06	Standard compound pressure gauge -1 to +3 kg/Sq.cm	As required
07	Standard Vacuum Gauge -760 mm Hg to 0 kg/Sq.cm	As required
08	Portable air compressor with drier and regulator rated for 10 kg/Sq.cm	As required
09	Manometer 0 to 1000 mm WC with hand bulb	As required
10	Vacuum pump with standard vacuum gauge	As required
11	Standard Milliamps Source (Digital)	As required

Sl.No.	Description	Quantity
12	Standard Millivolts Source (Digital)	As required
13	Mercury Manometer different range	As required
14	DC Power Supply , 24 V ; 5A	As required
15	Single Phase Variac 250V; 10A	As required
16	Glass Thermometers of ranges in Deg C as below : 0-120 ; 0-200; 0-600	As required
17	Tong tester AC 5/10/25 ; KEW Snap Make	As required
18	Function Generator	As required
19	Hand Operated Megger 500V ; 2.5 kV / 100 M Ohms	As required
20	Torque wrench	As required
21	AC Voltmeter 0-125 ; 250 ; 625V	As required
22	AC Ammeter 0-2A ; 10A	As required
23	Analog Multimeter Motwane Make	As required
24	Digital Multimeter 3 1/2 Digit	As required
25	Digital Multimeter 4 1/2 Digit	As required
26	Wire wrapping tool	As required
27	Oscilloscope	As required
28	Soldering irons, soldering pump, Vacuum cleaner, Air blower etc.	As required

B. List of Recommended Tools & Plants

S.No.	DESCRIPTION	QUANTITY
01	Steel wire ropes	As required
02	Chain pulley block / turfer	As required
03	2 " size pipe bending machine	As required
04	Grinding machine	As required
05	Drilling machines : 1/4" , ½" , 3/4" , 1 "	As required
06	Ttube bender and cutter sizes 6 mm ;8 mm ;1/2",1/4"	As required
07	Dye sets for threading upto 2 " pipe	As required
08	Set of spanners	As required
09	Allenkey sets	As required
10	Bench vice	As required.
11	Spirit level	As required
12	Tap sets for both BSP & NPT threads upto 1 "	As required
13	Measuring instruments like micrometers,calipers etc.	As required
14	Welding generator	As required
15	Welding transformer	As required
16	TIG Welding set	As required
17	Mechanical tool kit for fitters	As required
18	Electrician tool kit	As required

19	Crimping tool	As required
20	Flood light fittings	As required
21	Fire extinguishers	As required
22	Distribution boards with power cable complete as required with energy meter	As required
23	Hydraulic test pump rating 750 kg/sq.cm	As required
24	Painting brush	As required
25	Fire proof tarpaulin	As required
26	Safety belts & safety helmets	As required
27	Telephone sets	As required

Note:

a) T & Ps mentioned in above list are the suggestive requirement considering parallel working. However, mobilization schedule, quantity/numbers, capacity and period of T&Ps deployment will be mutually agreed at site as per actual requirement and contractor has to adhere to the same.

b) List of T&Ps required for the completion of entire scope of works shall be listed by the contractor and approval shall be obtained from BHEL Site. Numbers / time of requirement will be reviewed from time to time at site and contractor will provide required T&Ps / equipment to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL.

c) Vendor will give advance intimation prior to dispatch. Also on completion of the respective activity, demobilization of T&Ps in total or in part can be done with the due approval of engineer in charge. Retaining of the T&Ps during the contract period will be mutually agreed in line with construction requirement.

1.4.3. **ACCURACY REQUIREMENT OF TESTING INSTRUMENTS**

Sl.No.	**Instrument / Tool**	**Range**	**Accuracy**	**Dial Size**
01	Digital Multimeter	Voltage 200 mV to 1000 V DC	± 1% + 1 digit	
		Philips Voltage 200 mV to 1000 V AC	± 1% + 1 digit	
		Philips Current 20 mA to 20 A AC	± 0.8% + 1 digit	
		Resistance (HCl) 2120 200* to 20 M*	± 0.5% + 1 digit	
		Resistance (Hcl) 2105 200* to 200M*	± 0.25% + 3 digits	
		Hcl Voltage 200 mV to 750 V	± 0.8% + 1 digit	

Sl.No.	Instrument / Tool	Range	Accuracy	Dial Size
		Philips Current 20 mA to 20 A DC	± 0.5% + digit	
		Hcl Current 200 mA to 010 A AC	± 1% + digit	
02	Analog Multimeter	Voltage 2.5 to 2500V AC	± 1.0%	
		Current 100 mA to 10A AC	± 2.0%	
		Current 250 micro A to 1A DC	± 1.5%	
		Resistance upto 100 ohms	± 3.0%	
		Voltage 2.5 V to 2500 V	± 1 %	
03	MV/mV Source	0 to 200 mA / 200mV	0.2%	
04	Hand operated Megger 500V /1000 V	Upto 200 m Ohms	± 5% at Centre scale	10”
05	Standard Pressure Gauges	0 to 1 kg/cm2	±0.25% LC– 0.02 kg/ cm2	10”
		0 to 6 kg/cm2	±0.25% LC– 0.1 kg/ cm2	10”
		0 to 10 kg/ cm2	±0.25% LC– 0.02kg/ cm2	10”
		0 to 25 kg/ cm2	±0.25% LC– 0.25kg/ cm2	10”
		0 to 60 kg/ cm2	±0.25% LC– 0.1kg/ cm2	10”
		0 to 250 kg/ cm2	±0.25% LC– 2.5kg/ cm2	10”
		0 to 400 kg/ cm2	±0.25% LC– 2.5 kg/ cm2	10”
		0 to 600 kg/ cm2	±0.25% LC– 2.5 kg/ cm2	10”
		0 to 1000 kg/ cm2	±0.25% LC– 1.0 kg/ cm2	10”
06	Dead Weight Tester	0 to 400	LC – 5 kg/cm2	
		0 to 600	LC – 5	

Sl.No.	Instrument / Tool	Range	Accuracy	Dial Size
			kg/cm2	
07	Standard Hg in glass Thermometer	0 to 100^{0}C	LC - 1^{0}C	
		0 to 110^{0}C	LC - 1^{0}C	
		0 to 250^{0}C	LC - 1^{0}C	
		0 to 150^{0}C	LC - 1^{0}C	
		0 to 360^{0}C	LC - 1^{0}C	
		0 to 100^{0}C	LC - 1^{0}C	
08	Single Phase Variac	15 A Capacity	N/A	
09	Power Pack	0 to 50 V DC, 3A	± 2%	
10	Vibration Measuring Equipments	Velocity up to 50 mm/sec	± 0.5% mm/sec	
		Displacement upto 300 microns	± 2 microns	
11	Tong tester	0/300/600 A AC	± 5%	
		0 to 300 A DC	± 5%	
12	Tacho Meter (Hand held)	0 to 4000 rpm	± 5%	
13	Phase Sequence Meter		N/A	
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	± 5% at Centre Scale range	
15	DC Ammeter	0 to 300 A	± 10%	
16	DC Voltmeter	0 to 500 V	± 10%	

Note:

1. For loading and transportation, all necessary T & P such as Trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor. All the tools & plants required for this scope of work, except the tools & plants provided by BHEL are to be arranged by the contractor within the quoted rates.

2. Note for Contractor's Instruments and T&Ps:

a. The contractor shall arrange all the above T&P, equipment and instruments as indicated except testing instruments which are proprietary in nature.

b. The contractor at their cost shall arrange all cranes and truck / tractor, trailers required for material handling purpose and also cranes required for erection.

c. Any other tools and plants instruments and equipment required in addition to the above for the successful completion of this job will have to be arranged by the contractor at

their cost.

d. Necessary accessories for the above shall also be provided by the contractor.

e. Contractor shall send all the instruments, equipment, measuring tools etc. for testing and calibration periodically from time to time, as required by BHEL, and necessary calibration certificates are to be submitted to BHEL before use.

f. All testing instruments shall have calibration certificate issued by recognized / accredited agencies.

g. List of such agencies and periodicity of calibration required for different instruments will be furnished by BHEL at site.

h. Contractor shall maintain calibration records as per the BHEL format and produce them whenever called for by BHEL Engineers.

i. Contractors shall arrange experienced/qualified persons for using these calibration instruments at laboratory and also at work spot.

j. Wherever frequent calibration is required; contractor shall arrange adequate number of instruments such that the work does not suffer for want of test instruments.

1.4.4. T&Ps/equipment mentioned above is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers/ time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipment to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL. Vendor will give advance intimation and certification regarding capacity etc. prior to dispatch of heavy equipment. Also on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement

1.4.5. Computerized ferrules printing machine (min – 01 No.) shall be provided for making printed ferrules for all the cables.

1.4.6. **PROTECTION / HANDLING OF TOOLS AND PLANT ARRANGED BY THE CONTRACTOR**

1.4.6.1. Equipment, vehicles, tools and plants and materials brought to site by the contractor from their resources shall have distinctive identification marks and the contractor shall intimate the description and quantity to BHEL in writing.

1.4.6.2. All construction materials brought by the contractor shall have prior approval regarding quality and quantity by BHEL. The contractor shall also provide without extra cost necessary enclosures containers and protective materials for proper storage of materials inside, whenever so instructed by the purchaser without any extra cost.

1.4.6.3. No material or equipment or tools etc., shall be taken out of the work-site without the written consent of BHEL.

1.4.6.4. BHEL shall not be responsible for the safety and protection of the materials of the contractor and the contractor shall make their arrangements for proper watch and ward for their materials.

1.4.6.5. Until such time the work is taken over by BHEL, the contractor shall be responsible for proper protection including proper fencing, guarding, lighting, flagging, and watching. The contractor shall during the progress of work properly cover up and protect any part of the work liable to damage by exposure to the weather and shall take every reasonable precaution against accident or damage to the work from any cause.

1.4.6.6. In the event of non-mobilisation of Tools, Plants, Machinery, Equipment, Material or non-availability of the same owing to breakdown and as a result progress of work suffered, BHEL reserves the right to make alternative arrangement (available or higher capacity) in line with SCC clause no. 4.2.1.7 and hire charges shall be applicable as under:

i. **BHEL provides its own Capital T&P:** If BHEL provides owned T&P then BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges applicable (as enclosed in Part II of Volume IA, Technical Conditions of Contract) as per following cases:

- In case the T&P is specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to outside agencies other than contractors working for BHEL' will apply.

- In case the T&P is not specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to contractors working for BHEL' will apply.

The hire charges of Capital Tools & Plants are exclusive of operating expenses e.g., Operator, fuel & Consumables and the same shall be arranged by the contractor at their cost.

ii. **BHEL provides hired T&P:** In all cases other than that specified in Sl. No. (i) above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor.

1.4.6.7.

CALIBRATION RECORD OF SUB-CONTRACTOR'S INSTRUMENTS

Format No. CP:PEX:FOX

Name of Site:

Name of Sub-Contractor:

Sl.No.	Name of the Instrument	Instrument REGN.No.	Date of Entry / Exit	Periodicity of Calibration	Calibration Details
					Date of Cal: Cal. Agency: Next Due Date:
					Date of Cal: Cal. Agency: Next Due Date:
					Date of Cal: Cal. Agency: Next Due Date:

VOLUME-IA PART – I CHAPTER – V
T&Ps AND MMEs TO BE DEPLOYED BY BHEL ON SHARING BASIS

T&Ps AND MMEs TO BE DEPLOYED BY BHEL ON SHARING BASIS

1.5.1. List of T&Ps to be made available by BHEL to contractor free of hire charges on sharable basis is as below.

1.5.1.1. EOT Crane at TG Hall without operator based on requirement.

1.5.2. EOT crane without operating personnel shall be made available in the TG Hall free of charge. The contractor has to arrange operator for EOT Crane. EOT crane will be allocated for execution of C&I work including shifting the panels within power house building on sharing basis at free of hire charges. The decision of BHEL Engineers will be final with regard to allotment of crane.

1.5.3. Experienced Crane operator for EOT crane to be arranged by the bidder at their cost.

1.5.4. Providing manpower assistance required for free movement of Trailing cable of EOT Crane is also scope of the bidder at their cost.

1.5.5. The availability of crane is likely to be hampered from time to time due to routine preventive maintenance or breakdown maintenance. Contractor has to make alternative arrangement or plan / modify / alter their activities to suit the above conditions and the contractor will not be liable for any compensation or extension of time due to this non-availability, for maintaining the erection schedule.

1.5.6. In the event of the crane not available for longer duration due to major breakdown or any other reasons, BHEL will reschedule the work in consultation with bidder and direct the bidder to concentrate on other areas till such time the cranes are made available.

1.5.7. Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

1.5.8. All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections for the BHEL issued T & Ps shall have to be arranged by the contractor at their cost.

1.5.9. Contractor shall make good any loss or damage to the equipment's supplied to them and day to day maintenance and operations of equipment's shall be borne by the contractor including all consumables like petrol, oil and air filters etc.

1.5.10. BHEL may provide either BHEL owned or hired 75T (or above capacity) cranes as per site requirement for erection at the discretion of BHEL.

1.5.11. In the event of providing BHEL owned cranes:

1.5.11.1. BHEL shall provide crane operator at free of charges.

1.5.11.2. Fuel and lubricants are to be arranged by the contractor within the quoted rate.

1.5.11.3. Maintenance for the BHEL own cranes shall be carried out by BHEL. However, all the consumables for the maintenance of BHEL own cranes shall be provided by the contractor within the quoted rates. The Tentative List of consumables required to be provided by contractor from the BHEL/OEM recommended supplier is as below:

a. Engine Oil
b. Fuel Filters
c. Air Filters
d. Hydraulic Oil
e. Hydraulic Filters
f. Gear Oil
g. Engine Oil Filter
h. Oil Separator Filter
i. Rope
j. Grease
k. Maintenance for the BHEL cranes shall be carried out by BHEL. The bidder shall extend support if required for routine maintenance works without any additional cost.

1.5.12. <u>In the event of providing hired cranes:</u>

1.5.12.1. Crane Operators for hired cranes will be provided by BHEL, free of charges.

1.5.12.2. Fuel and lubricants are to be arranged by the contractor within the quoted rate.

1.5.13. Cranes provided by BHEL are only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.

1.5.14. Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional T & Ps which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at their cost. In case if the contractor fails to provide such equipment, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.

1.5.15. Any loss / damage to any or part of the BHEL T&Ps by the contractor shall have to be replaced or otherwise cost thereof shall be recovered from the contractor.

1.5.16. All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections shall have to be arranged by the contractor at their cost.

1.5.17. Necessary electrical / water / air connection required for operation of any of the tools & tackles shall be in the Contractor's scope.

1.5.18. Apart from the above mentioned tools, any other tools and plants including suitable Jacks / Hydraulics jacks required for satisfactory completion of the work has to be arranged by the contractor.

1.5.19. For the cranes, the required consolidation and preparation for placing crane for operation is under bidder scope and also necessary plates / sleepers required for marching operation shall be provided by the contractor within quoted rates.

1.5.20. For movement of cranes etc., it may become necessary to lay sleeper bed for obtaining leveled safe approach for usage of equipment. It shall be the responsibility of the contractor to lay necessary sleepers. The sleepers shall be arranged by the contractor at their cost.

1.5.21. The contractor at their cost shall arrange for grouting of anchor points of T&Ps issued to them. Necessary grout materials are to be arranged by the contractor at their cost.

1.5.22. In case of non-availability of any of these equipment, due to any reason i.e., unavoidable breakdown, major overhaul or any other reason etc., the contractor should make arrangement at their cost to meet the erection targets. No extra claim will be admitted due to non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.

VOLUME-IA PART – I CHAPTER-VI
TIME SCHEDULE

TIME SCHEDULE

1.6.1.1. The entire work of erection testing and commissioning as detailed in the Tender Specification shall be completed within **13 (Thirteen)** months from the date of commencement of work at site.

1.6.1.2. During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

1.6.1.3. The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer at site. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

1.6.1.4. The contractor is required to refer Form 15 in Volume 1- BOOK 2 for all the instructions to be taken immediately after receipt of LOI.

1.6.2. **COMMENCEMENT OF CONTRACT PERIOD**

1.6.2.1. The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work at site. In case of discrepancy the decision of BHEL engineer is final.

1.6.3. **MOBILIZATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIOING ETC.,**

1.6.3.1. The activities for erection, testing etc. shall be started as per directions of Construction manager of BHEL. The contractor has to augment their resources in such a manner that following major milestones of erection & commission are achieved on specified schedules:

Milestone Activity	**(Completion from the commencement of contract period)**
1. Readiness for Boiler Light Up	4th Month
2. Readiness for Synchronization	7th Month
3. Readiness for Trial Operation	9th Month
4. Balance work completion, pending points, punch points liquidation	13th Month
Intermediate Milestone	**(Completion from the commencement of contract period)**
1. Readiness for Boiler Light Up (M1)	4th Month

2. Readiness for Synchronization (M2)	7th Month

1.6.3.2. In order to meet above schedule in general, and any other intermediate targets set, to meet customer / project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL Engineer.

1.6.3.3. In case the project is to be advanced, the erection works in the scope of the contractor is to be advanced to meet the project requirement. No extra payment whatsoever shall be paid on this account.

1.6.4. **PENALTY FOR INTERMEDIATE MILESTONES**

1.6.4.1. M1 and M2 shall be intermediate Milestones for the work..

1.6.4.2. In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones with reference to Form 14.

1.6.4.3. Incase delay in achieving M1 milestone is solely attributable to the contractor, 0.5% per week of executable contract value* limited to Maximum 2% executable contract value will be withheld.

1.6.4.4. Incase delay in achieving M2 milestone is solely attributable to the contractor, 0.5% per week of executable contract value* limited to maximum 3% of executable contract value will be withheld.

1.6.4.5. Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 milestone.

1.6.4.6. Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @ 10% of RA Bill amount from subsequent RA bills.

1.6.4.7. Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of intermediate milestones shall be adjusted against LD or released as the case may be.

1.6.4.8. In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted in to recovery.

1.6.4.9. **Note:** * Executable contract value-value of work for which inputs/fronts were made available to contractor and were scheduled for execution till the date of achievement of that milestone.

1.6.5. **CONTRACT PERIOD**

1.6.5.1. The contract period for completion of entire work under scope shall be **13 (Thirteen) months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier.

1.6.6. **GUARANTEE PERIOD**

The guarantee period of 24 months shall commence from the date of handing over of the Unit to Customer (or) Six months from the date of first synchronization of the Unit, whichever is earlier.

(Provided all erection, testing, commissioning and pending points works are completed in all respects).

VOLUME-IA PART – I CHAPTER-VII
TERMS OF PAYMENT

1.7.1. **Terms of Payment:**

The progressive payment for erection, testing and commissioning on accepted rate / price of contract value will be released as mentioned below.

1.7.2. Progressive Payment against monthly running bills will be made up to 85 % of the value of **the completed erection** on Pro rata basis as per Clause no 1.7.2.1. to 1.7.2.13. of the following table.

Sl. No.	Activity/Work Description	% of unit rate
I	**PRO RATA PAYMENTS (85%)**	
1.7.2.1.	**Cable tray and accessories**	
1.1	Fabrication and fixing/welding/bolting in position	60%
1.2	Earthing of cable trays	15%
1.3	Tagging of cable trays (painting cable tray numbers on sides)	5%
1.4	Covering of trays where ever envisaged	5%
	Total =	**85%**
1.7.2.2.	**Cable laying and Cable Termination (Power Cables)**	
2.1	Laying of cables	45%
2.2	Glanding, Termination and tagging of cables	15%
2.3	Dressing and clamping of cables	10%
2.4	Testing and charging of cables	15%
	Total =	**85%**
1.7.2.3.	**Cable laying and Cable Termination (Control and Signal Cables)**	
3.1	Laying of cables	45%
3.2	Glanding, Termination and tagging of cables	15%
3.3	Dressing and clamping of cables	10%
3.4	Shielding of cables	5%
3.5	Testing and charging of cables	10%
	Total =	**85%**
1.7.2.4.	**Junction box/Push button**	
4.1	Erection including fixing of terminal blocks where ever applicable	75%
4.2	Labelling (both inside and outside), Name plate fixing where ever applicable and Earthing & connection of connected equipment	10%

	Total =	**85%**
1.7.2.5.	**Conduits/impulse pipe/tubes**	
5.1	Fabrication, Laying and Erection	50%
5.2	Leak Test/Hydraulic Test (where ever applicable, other wise clubbed with next activity)	20%
5.3	Dressing, clamping, tagging and painting where ever applicable	8%
5.4	Testing & commissioning of associated equipment/system	7%
	Total =	**85%**
1.7.2.6.	**Fabrication and Installation of Structural Steel Materials**	
6.1	Fabrication, Erection, Alignment , Welding/bolting, painting and where ever applicable chipping/grouting/painting	65%
6.2	Erection of associated Items/Equipments/Systems as applicable	20%
	Total =	**85%**
1.7.2.7.	**DCS/FURNITURE DESK/ RACK/ENCLOSURE/HMI/MIS System/All type of control panels**	
7.1	Erection and alignment	50%
7.2	Fixing of loose items/instruments where ever applicable	5%
7.3	Pre commissioning checks, Charging of panel and Loop testing etc	15%
7.4	System commissioning	15%
		85%
1.7.2.8.	**UPS/Battery Charger/Battery/ACDB**	
8.1	Erection and alignment	50%
8.2	Fixing of loose supplied items/instruments where ever required	5%
8.3	Pre commissioning checks, Charging of panel and Loop testing and pouring of electrolytes	15%
8.4	System commissioning	15%
		85%
1.7.2.9.	**For all types of Instruments/Devices/Sensors/Cells/Probes, etc.**	
9.1	Calibration/Testing/Pre erection checks	30%
9.2	Erection/Placement and fixing of loose items/accessories	30%
9.3	Pre commissioning checks/loop testing/Simulation testing as required	10%
9.4	Remote/local commissioning as required	15%
	Total =	**85%**

1.7.2.10.	**Testing/Commissioning of Equipment erected by other agencies**	
10.1	Removal & refixing/Fixing of loose supplied components of instruments, (including tubing/hose, regulators, etc)	30%
10.2	Calibration/Local testing - commissioning readiness	30%
10.3	Local Commissioning & Loop Testing as required	10%
10.4	System Commissioning or Remote Commissioning	15%
	Total =	**85%**
1.7.2.11.	**Power Cylinders**	
11.1	Erection and alignment of Power Cylinders	30%
11.2	Fixing of loose supplied items	30%
11.3	Loop Checking, Calibration and Local commissioning	20%
11.4	System/Remote commissioning	5%
	Total =	**85%**
1.7.2.12.	**Other Items (Items not covered under above heads)**	
12.1	Erection	50%
12.2	Alignment	10%
12.3	Testing	15%
12.4	Completion of Commissioning of the respective item/equipment	10%
	Total =	**85%**
1.7.2.13	**For Supply Items(if applicable)**	
13.1	On submission of running bill along with the Stores Receipt/Voucher/Stores endorsement issued by BHEL	85%
	Total =	**85%**

1.7.3. Further 15 % payment on pro-rata basis common to all PG shall be released on achievement of the following stage / milestones events (as mentioned in Clause no 1.7.3.1 of the following table) for the **erected items in the package**.

1.7.3.1.	**STAGE / MILESTONE PAYMENTS (15%)**	**% of unit rate**
1.7.3.1.1.	Boiler Light Up	1%
1.7.3.1.2.	ABO/Chemical/EDTA cleaning	1%
1.7.3.1.3.	Safety Valve floating (Electromatic Relief Valves)	1%
1.7.3.1.4.	Rolling and Synchronization	2%
1.7.3.1.5.	Coal Firing	1%
1.7.3.1.6.	Full Load	2%
1.7.3.1.7.	Trial Operation of Unit	2%
1.7.3.1.8.	Area cleaning, temp structure cutting/ removal and return of scrap	1%
1.7.3.1.9.	Punch List points / pending points liquidation	1%
1.7.3.1.10.	Submission of 'As Built Drawings'	1%
1.7.3.1.11.	Monthly Material Reconciliation	1%
1.7.3.1.12.	Completion of Contractual Obligation	1%
	Total for Stage / Milestone Payments (15%)	**15%**

1.7.4.

1.7.4.1.	PG Test Instruments installation (50%) and removal (50%)	100%

1.7.5. **No claim what so ever may be, will be entertained under this contract, after duly signing the final bill along with measurement books and accepted by BHEL.**

VOLUME-IA PART – I CHAPTER-VIII
TAXES AND DUTIES

1.8.1 All taxes and duty other than GST & Cess and BOCW Cess

The contractor shall pay all (**except the specific exclusion viz GST & Cess and BOCW Cess, both of which are dealt separately**) taxes, fees, license charges, deposits, duties, tools, royalty/ seigniorage, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods (including construction material viz. sand, coarse aggregates, moorum, borrowed earth, etc.) & services consumed and output goods & services delivered in course of his operations in executing the contract **and the same shall not be reimbursed by BHEL**. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit.

1.8.2 Goods and service Tax (GST) -

For GST Registered bidder:

1.8.2.1 The successful bidder shall furnish proof of GST registration under GST Law, covering the supply and services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by the successful bidder on BHEL for this project/ work. The bidder to specify in their offer the category of registration under GST i.e. Regular dealer or composite dealer**.**

1.8.2.2 Bidder's price/rates shall be exclusive of GST & GST Compensation Cess (herein after termed as GST).

1.8.2.3 Vendor / Contractor require to ensure that all Input Tax benefits as per existing laws have been considered.

1.8.2.4 Price quoted by the composite dealer shall be considered as inclusive of GST. In the event of any change in the status of vendor / Contractor from composite to regular dealer after the submission of the bid but before completion of supply of services or goods, Contract value shall be amended to remove the embedded GST and any ITC benefit arising due to change of status, which shall be passed on to BHEL. GST paid on the amended contract value shall be reimbursed at actuals against the Tax invoice if BHEL is able to take input tax credit. However, no reimbursement of GST shall be made if BHEL is not able to take input tax credit. The decision of BHEL in this regard will be final and binding on the vendor/contractor.

1.8.2.5 It is the responsibility of the vendor / contractor to adhere to all the provisions of E- Invoicing under GST Act (if applicable). As per the E-Invoicing provisions vendor / Contractor has to generate IRN and QR Code from the E-Invoicing system and the same need to be printed in the invoice submitted to their customer. Invoices that do not comply to the above requirements, will not be accepted by BHEL. If the successful Bidder is not falling under the preview of E-Invoicing, then he has to submit a declaration in that respect along with relevant financial statements. However, applicability of E-invoicing, shall be verified from the E-Invoicing portal on submission of vendor / Contractor GSTN. BHEL shall reimburse GST only if all the provisions of E-invoicing are complied with.

1.8.2.6 It is the responsibility of the vendor/ Contractor to issue the Tax Invoice strictly as per the format prescribed under the GST Act within the prescribed time period in order to enable BHEL to avail input tax credit within the due date. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge. Tax invoice should also contain below details

a. Contractor Name and Contact details.
b. GST No of Contractor
c. PAN No of Contractor
d. Document Type: Tax Invoice/ Debit Note/ Credit Note
e. Category: B2B / B2C (B2B is only applicable w.r.t BHEL)
f. Customer Name and Contact details / Bill To Details (as mentioned below)
g. Unique Tax Invoice Number
h. Invoice Date
i. IRN No, QR Code, Acknowledgment No and Acknowledgment Date generated from E-Invoice Portal as per E-invoicing provisions under GST Act (If applicable)
j. Place of Supply (as mentioned below)
k. Description of service provided
l. 8 Digit SAC code
m. GST Rate
n. Gross value of Invoice
o. Taxable Value
p. Tax / GST Amount
q. Total Invoice value including GST.

Above are inclusive and not exhaustive list of requirements.

1.8.2.7 Bidder should mention the "Bill To "and "Place of supply" as below in the Tax Invoice

Bill To: Location of BHEL Site office

---,

State: ---
GSTN of BHEL: ---

Place of Supply: Location of BHEL Site office

---,

State: ---
GSTN of BHEL: ---

(Above details will be given later, contractors may contact BHEL, PSSR before billing)

1.8.2.8 In case of supply of goods contract, the successful bidder must promptly provide details of the dispatched items on the same day they are removed for shipment to the BHEL site. This intimation must include all relevant information and documents about the goods and a scanned copy of the tax invoice. If any financial liabilities arise for BHEL due to non-compliance with GST laws resulting from the bidder's delay in providing this information, the bidder will be held liable, unless the delay is directly attributable to BHEL.

1.8.2.9 BHEL will reimburse the GST amount claimed by the Vendor/Contractor against a tax invoice along with the amount due to the contractor in the RAB. However, If the Vendor/Contractor fails to fulfill the GST compliance requirements detailed below for any preceding invoice, BHEL reserves the right to recover an amount equivalent to the reimbursed GST from the subsequent bills as a measure against statutory non-compliance. Additionally, an amount equivalent to the GST claimed in subsequent bills will be withheld until statutory compliance for the prior invoice is ensured.

In the case of one-time vendors/contractors or the Vendor/Contractor's final bill, BHEL will withhold an amount equivalent to the GST claimed from the same bill towards pending statutory compliance. This withheld amount will only be released once the following GST compliance requirements are fully satisfied.

GST Compliance Requirements:

a. Vendor / Contractor must provide the original copy of Tax invoice /debit note as per the prescribed format under the GST act within the prescribed time period in order to enable BHEL to avail input tax credit within the due date.

b. The details of the invoice or debit note referred to in clause (a) must be furnished/filed by the Vendor/ Contractor in the statement of outward supplies (presently in GSTR1 or IFF) and such details should get reflected in the BHEL GST login (both in GSTR 2A and GSTR 2B) in the manner specified under GST Act.

c. Details of vendor/contractor invoice reflected in BHEL GST login should match with the details in the tax invoice submitted by the vendor/contractor, including the invoice number, invoice date, GSTIN, and place of supply. Additionally, the status of GSTR-1 and GSTR-3B filings must be "Yes."

d. The tax charged in the invoice /debit note referred to in clause (a) must be paid to the Government by the Vendor/Contractor, either in cash or through the utilization of input tax credit.

1.8.2.10 In case, any GST credit is delayed/denied to BHEL or BHEL has to incur any liability (like interest / penalty) due to non/delayed receipt of goods or submission of tax invoice after the expiry of timeline prescribed in the relevant GST Act for availing ITC, or any other reasons not attributable to BHEL, Then the same shall be recovered from the vendor/contractor along with interest levied/ leviable on BHEL.

1.8.2.11 GST shall be levied on recoveries, wherever applicable and same shall be recovered from payments. BHEL shall issue / raise Tax invoice on contractor/vendors for such recoveries.

1.8.2.12 E-way bills / Transit passes / Road Permits, if required for materials / T&P etc., bought into the project site is to be arranged by the Vendor / Contractor themselves. BHEL shall not issue or raise any Road Permit/ E- Way Bill for this purpose. Any claim or demand raised by the GST department for non-generation / non-submission of E-way bill shall be to the contractor/ vendor account

1.8.2.13 BHEL shall not reimburse any expenditure incurred by the contractor towards demand, additional liability or interest / penalty etc., raised by the GST

department due to issues such as wrong rates / wrong classification of services or goods.

1.8.2.14 Where GST is payable by BHEL under reverse charge basis, any demand raised or any interest or penalty levied / leviable by the GST department due to non-submission or delayed submission of invoice by the contractor or for any other reason not attributable to BHEL, the same shall be recovered from the vendor/contractor.

1.8.2.15 Tax Deduction at Source (TDS) as per Sec 51 of the CGST Act shall be deducted (if applicable). GST TDS certificate in Form GSTR -7A shall be issued to be contractor. However, GST TDS certificate can be generated only if the contractor accepts the TDS details uploaded by BHEL and files his return. If any specific exemption from GST TDS is applicable to any contractor/vendor, then a declaration to that effect along with relevant documents as may be required by BHEL, substantiating such exemption in line with GST law provisions or notification, shall be submitted by the vendor/contractor.

For GST Unregistered bidder:

1.8.2.16 In case, bidder is not required to register under Goods and service Tax (GST) & Cess, the same is to be specified in the offer.

1.8.2.17 Successful bidder to furnish a Self-declaration that registration under GST is not required or not applicable as per the provisions of GST Law along with relevant document and provisions in the GST law.

1.8.2.18 In case BHEL has to incur any liability (like interest / penalty etc.) due to non-compliance of GST law in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.

1.8.2.19 TDS under GST (as & when applicable) shall be deducted at prevailing rates on gross invoice value.

1.8.2.20 If RCM is made applicable at a later date, GST will be paid by BHEL to the department at applicable rate treating the quoted the price as inclusive of GST if BHEL is not able to take Input tax credit.

1.8.2.21 In the event of any change in the status of bidder from unregistered to registered under the GST law after the submission of bid but before the completion of supply of services or goods, the same need to be intimated and all the clauses applicable for Registered bidder need to be followed. The vendor/ contractor is required to pass on the ITC benefit arising due to change of status, to BHEL. Contract value shall be amended accordingly. GST paid on the amended contract value shall be reimbursed at actuals against the Tax invoice only if BHEL is able to take input tax credit.

1.8.3 Statutory Variations

1.8.3.1 BHEL shall pay statutory variation only for GST, and no other variations shall be payable

1.8.3.2 In general, Statutory variation for GST is payable to the Vendor/ Contractor during the contract period including extension thereof. Beyond the contract period, BHEL will reimburse the actual applicable tax only if BHEL is able to take the input tax credit. However, the decision of BHEL in this regard will be final and binding on the vendor/contractor

1.8.4 New Taxes/Levies –

In case Government imposes any new levy / tax after submission of bid during the tenure of the contract, BHEL shall reimburse the same at actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract. However, Contractor/ Vendor shall obtain prior consent from BHEL before depositing new taxes and duties.

Any benefits arise out of new tax levies and/or abolition of existing taxes must be passed on to BHEL.

The decision of BHEL in this regard will be final and binding on the vendor/contractor.

1.8.5 Direct Tax

1.8.5.1 Vendor/ Contractor is required to update himself on its own and comply with provisions of Indian Income Tax Act as notified from time to time. Purchaser shall not be liable towards liability of income tax accruing to the vendor/contractor of whatever nature including variations thereof, arising out of this Order/ Contract, as well as tax liability of the vendor/ Contractor and his personnel

10.8.5.2 Deductions of Tax at source as per Income Tax Act, at the prevailing rates shall be effected by the Purchaser before release of payment, as a statutory obligation, if applicable. TDS certificate will be issued by the Purchaser as per the statutory provisions. The Vendor/Contractor has to mention their Permanent Account Number (PAN) and GSTIN in all invoices.

1.8.6 BOCW Act & BOCW Welfare Cess Act

1.8.6.1 Contractor's price/rates shal be exclusive of BOCW Cess .

1.8.6.2 The Contractor should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice Of Commencement / Completion of Building other Construction Work) to the respective Labour Authorities i.e.,

a. Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.–NTPC, NTPL etc.
b. Appropriate State authorities in respect of the project premises which is under the purview of State Govt.

1.8.6.3 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL.

1.8.6.4 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc.

1.8.6.5 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.8.6.6 Contractor shall make remittance of the BOCW Cess as per the Act in consultation with BHEL as per the rates in force (presently 1%). BOCW remittance should be made only after obtaining prior consent from BHEL. BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.

1.8.6.7 Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as it deems fit. Only upon total compliance with the BOCW Act and the discharge of total payment of Cess (in consultation with BHEL) under the BOCW Cess Act by the Contractor, BHEL shall consider refund of the amounts.

VOLUME-IA PART – I CHAPTER IX

WEIGHT SCHEDULE/BOQ

1.9.1. **BOQ**

Item No.	Description	UOM	Qty
A	**EDN SCOPE**		
A.1.0	**Placement, Alignment , erection, electrical interconnection, testing and commissioning of SG DCS Panels**		
A.1.1	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CJF49, 50)	Nos	1
A.1.2	Suite of three Cubicles Approx. Size: 2250 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1200 kg. (CJF97,98,99 & CJF 06,07,08)	Nos	2
A.1.3	Suite of four Cubicles Approx. Size: 3000 mm(W) X 750 mm(D) x 2067mm(H); Approx. weight 1600 kg. (CJF11,12,13,14, CJF16,17,18,19, CJF21,22,23,24, CJF26,27,28,29 & CJF61,62,63, 64 & CJF66,67,68,69)	Nos	6
A.1.4	Suite of five Cubicles Approx. Size: 3750 mm(W) X750 mm(D) x 2067 mm(H); Approx. weight 2000 kg. (CJF01,02,03,04,05)	Nos	1
A.2.0	**Placement, Alignment, erection, electrical interconnection, testing and commissioning of TG DCS Panels**		
A.2.1	Single Cubicle Approx. Size: 750 mm(W) X750 mm(D) x 2067 mm(H); Approx. weight 400 kg. (CCA20, CJJ08, CCA91 & CWW01)	Nos	4
A.2.2	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CCA10,11)	Nos	1
A.2.3	Suite of three Cubicles Approx. Size: 2250 mm(W) X 750 mm(D) x 2067mm(H); Approx. weight 1200 kg. (CCA01,02,03, CCA04,05,06 & CJJ03,04,05)	Nos	3
A.2.4	Suite of four Cubicles Approx. Size: 3000 mm(W) X750 mm(D) x 2067 mm(H); Approx. weight 1600 kg. (CJJ20,21,22, 23 & CJJ30,31,32,33)	Nos	2
A.3.0	**Placement, Alignment, erection, electrical interconnection, testing and commissioning of BOP C&I DCS Panels**		
A.3.1	Single Cubicle Approx. Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg. (CRE71, CRE72, CRE73, CTE01,CTE02,CTE03)	Nos	6
A.3.2	Suite of three Cubicles Approx. Size: 2250 mm(W) X 750 mm(D) x 2067mm(H); Approx. weight 1200 kg. (CRE09,10,11, CRE12,13,14, CRE15,16,17, CRE24,25,26, CRE27,28,29, CRE30,31,32, CRE39,40,41, CRE42,43,44, CRE45,46,47, CRE60,61,62, CRE63,64,65, CRE66,67,68)	Nos	12
A.3.3	Suite of four Cubicles Approx. Size: 3000 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1600 kg. (CRE01,02,03,04, CRE05,06,07,08, CRE20,21,22,23)	Nos	3

Item No.	Description	UOM	Qty
A.3.5	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CRE18,19, CRE33,34, CRE35,36, CRE37,38)	Nos	4
A.4.0	**Placement, alignment,erection, electrical interconnection, testing and commissioning of Network Panels.**		
A.4.1	Network Panel cum Power Dsitribution of Single Cubicle Approx. Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg - CNP33	Nos	1
A.4.2	Network Panel Single Cubicle Approx. Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg. (CNP11,CNP12)	Nos	2
A.4.3	Network Panel Single Cubicle Approx. Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg. (Common (for MIS) CNP31, CNP32, Station LAN CNP 51,CNP52)	Nos	4
A.5.0	**Placement, alignment, erection, electrical interconnection, testing and commissioning of T&AVT DCS Panels**		
A.5.1	Single Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CFA01)	Nos	1
A.6.0	**Placement, alignment, erection, electrical interconnection, testing and commissioning of CPU DCS Panels**		
A.6.1	Interposing Relay Panel Approx. Size:750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg (CTE21, CTE22, CTE23)	Nos	3
A.6.2	Suite of two Cubicles in service vessel area Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CRA01,02)	Nos	1
A.6.3	Suite of two Cubicles in service vessel area Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CRA03,04)	Nos	1
A.6.4	Suite of four Cubicles Approx. Size: 3000 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1600 kg. CRA05,06,07, 08	Nos	1
A.7.0	**Placement, alignment, erection, electrical interconnection, testing and commissioning of the following AC & Ventilation System DCS Panels in Service Building CEO, Admin Building CER and ESP CER Unit-2 as applicable**		
A.7.1	Interposing Relay Panel Approx. Size:750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg (Unit#2- CTE26, CTE 29, CTE 30)	Nos	3
A.7.2	**Void**		
A.7.3	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CRF22,23)	Nos	1
A.7.4	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (Unit#2- CRF20,21)	Nos	1
A.7.5	Suite of three Cubicle Approx. Size: 2250 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1200 kg. CRF01,02,03, CRF04,05,06)	Nos	2
A.8.0	**VOID**		

Item No.	Description	UOM	Qty
A.9.0	**Placement, alignment,erection, electrical interconnection, testing and commissioning of MRS DCS Panels for Unit#2**		
A.9.1	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CRE55,56, CRE57,58)	Nos	2
A.10.0	**VOID**	-	-
A.11.0	**Placement, alignment,erection, electrical interconnection, testing and commissioning of STP and ETP DCS Panels**		
A.11.1	Suite of four Cubicles Approx. Size: 3000 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1600 kg. (CRB51,52,53,54 for STP and CRB61,62,63,64 for ETP)	Nos	2
A.12.0	**VOID**		
A.13.0	**Placement, alignment, erection, electrical interconnection, testing and commissioning of BOP VMS Package Panels**		
A.13.1	Suite of three Cubicle Approx. Size: 2250 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1200 kg. (CRG01,02,03)	Nos	1
A.13.2	Suite of two Cubicles Approx. Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg. (CRG04,05, CRG06,07)	Nos	2
A.14.0	**VOID**		
A.15.0	**TURBINE SUPERVISORY SYSTEM FOR MAIN TURBINE**		
A.15.1	Meggitt VM600 system with 19" Rack(s) (with power supply unit, back panel, CPU module,I/O cards, relay cards, protection cards), TFT monitors, server, A3 Colour printer, Ethernet to FO convertor, interconnecting cables, etc. along with Panel CJJ 41 of Approx. Size and Weight of the Panel 750 x 800 x 2067 mm; 400 kg. (Panel CJJ 41 is already unloaded near Control Room) Collection of materials from stores, Preparation of mounting surface and mounting arrangement to suit the surface of the machine, Installation of JBs- Approx. 11 Nos., Laying & Terminations of Instrumentation cable from Local JB and Cabinet, Laying and termination of Power cable to TSS panel, Laying and termination of ethernet cables (as applicable), Laying and Termination of FO cables. (Mounting sensors on the Machines, Laying and termination of cables between sensors to Local JB, Pre-commissioning check, energizing cabinets & PC (as applicable), (Commissioning, Installation of software packages, handing over to the enduser are in the scope of OEM.)	Set	1
A.16.0	**Erection, Testing, Calibration and Commissioning of Field Instruments**		
A.16.1	Ultrasonic type level transmitter	Nos	19
A.16.2	Guided Wave Radar Type Level Transmitter	Nos	15
A.16.3	RTD with Thermowell	Nos	123
A.16.4	Pressure Gauge & Differential Pressure Gauge	Nos	187
A.16.5	Temperature Gauge	Nos	156

Item No.	Description	UOM	Qty
A.16.6	Level Switch- Conductivity Type for CRH drain pots consists of two nos of level probes, field mounted electronic control units-1 No., interconnecting cables 10 mtr	Nos	2
A.16.7	Void		
A.16.8	Temperature Transmitter	Nos	431
A.16.9	I/P Coverters for Burner Tilt & SADC	Nos	34
A.16.10	Air Filter Regulators for Burner Tilt & SADC	Nos	34
A.16.11	Electronic Transmitters (PT/DPT/LT-DP type/FT-DP type)	Nos	405
A.16.12	Thermocouple 'K' Type with Threaded Connection	Nos	168
A.16.13	Thermocouple 'K' Type with Flanged Connection	Nos	35
A.16.14	Thermocouple 'K' Type with Weld Pad	Nos	22
A.16.15	EWLI with all associated cabling and accessories	Set	3
A.17.0	**COAL BUNKER LEVEL MONITORING SYSTEM**		
A.17.1	3D Level Scanner comprising of 3D Level Scanner Body and 3D Level Scanner Head along with mounting arrangement with bolts and washers	Nos	7
A.17.2	Local Control Panel (Approx. dim. 750mm(L)X1035mm(H)X570mm(D))	Nos	2
A.17.3	Laying and Termination of 3P X 1.0 SQMM Shield and Armored Cable	Mtrs	175
A.17.4	Operator Station	Nos	1
A.17.5	COLOR LASER JET AUTO DUPLEX PRINTER –A4	Nos	1
A.18.0	**Erection of FLUE GAS ANALYZERS (Commissioning by OEM)**		
A.18.1	High temperature Oxygen Analyzer (in situ type) Consisting of insitu,flange mounted zirconium oxide type probe and electronics-1 cabinet, Verification gas cylinder and anlyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 50 Kg	Set	4
A.18.2	Low temperature Oxygen Analyzer (in situ type) Consisting of insitu,flange mounted zirconium oxide type probe and electronics-1 cabinet, Auto Enclosure for Remote Transmitter and auto calibration unit 600(H) X600(W) X 350(D), three calibration cylinders, Zero span , mid, one span cylinders along with accessories, probe cables, abrasive shield pipes-2020mm, SS316 Tube, 1/4" OD-25 metres, and wall mounted panel for Analyzer. inter connecting power & control cables etc. and associated accessories App.weight of analyser is 50 Kg	Set	8
A.18.3	**VOID**		

Item No.	Description	UOM	Qty
A.18.4	CO Analyser (In-Situ type) mounting at APH Consisting of CO Sensor head mounted on probe, In-situ Standard probe, 1.8 m insertion length (8"NB flange), Temperature transmitter with 1.5 m cable mounted on probe, Pressure transmitter with 1.5 m cable mounted on probe, Pneumatic Panel (approx. dim 600mmx800mmx300mm consisting of Digital Display Unit with 10 m cable, Power Supply with 10m cable & 10m cable each for zero solenoid, span solenoid, pressure switch, Air Dryer Unit, Mounting hard ware & flanges, Gas cylinders with SS regulator, SS Tube 6mm OD 25m, 6mm OD union Ferrule fittings-6Nos., PU Tube 6 mm OD-10m, Air compressor for air purging, Relay panel, Purge air failure alarm with fitting for gas analyzer, OFC Cabling as applicable , interconencting cables, power and control cables and all other associated accessories. Approx. weight of Analyser 150kgs	Set	3
A.18.5	Opacity Monitor (In Situ type) Consisting of Transceiver unit with 10m cable -02 No each, air purge unit-2nos., Signal processor unit, power supply unit, display control unit, Local/Display & Control unit (DDU) , fail safe shutter with 10 mtr cable -2 nos. , Actuator Control Unit (ACU) with 20m, 3 Core cable, Remote Calibration Unit, Mounting Hardware & Flanges, Temperature transmitter with 10m cable, Air blower unit with necessary hose, fittings & accessories, Pressure Switch with 20m cable, inter connecting power & control cables etc. The analyser mounting at elevation 71 mts and temperature transmitter at 71 mtrs on chimney.	Set	1
A.18.6	Flue Gas analyser - mounting location at Chimney elevation 71 mtrs Consisting of SOx, NOx, Sensor head(Inbuilt H2O, CO2 Channels) mounted on probe, In-situ Standard probe, 1.8 m insertion length (8"NB flange), Temperature transmitter with 1.5 m cable mounted on probe, Pressure transmitter with 1.5 m cable mounted on probe, Pneumatic Panel (approx. dim 600mmx800mmx300mm consisting of Digital Display Unit with 10 m cable, Power Supply with 10m cable & 10m cable each for zero solenoid, span solenoid, pressure switch, Air Dryer Unit, Mounting hard ware & flanges, Gas cylinders with SS regulator, SS Tube 6mm OD 25m, 6mm OD union Ferrule fittings-6Nos., PU Tube 6 mm OD-10m, Air compressor for air purging, Relay panel, Purge air failure alarm with fitting for gas analyzer & flow meter, PPM to MBTU Convertor & Isolator panel for chimney mounted analyser connectivity to display board, OFC Cabling as applicable, interconencting cables, power and control cables and all other associated accessories. Approx. weight of Analyser 150kgs	Set	1

Item No.	Description	UOM	Qty
A.18.7	Mercury analyser consist of sample probe with heated filter, mounting flange, heated sample tubes with RTD (length 110 mtrs), heated sample line, span zero gas calibration cylinders, peristatic pumps 2 nos, outdoor PLC panel size 800mm x 1700mm x 500mm, aprox weight of panel 300 Kg, Wall mounting type static AC power switching unit, mounted on chimney at 41 mtr elevation.	Set	1
A.18.8	Gas Flow analyser (InSitu non-contact Cross duct type) Consisting of upstream sensor head with 10m cable, downstream sensor head with 10m cable, Air Purge Unit-2nos., Power Supply Unit, Signal Processing Unit, Digital Display Unit with 10m cable, mounting hardware and flanges, along with inter connecting power & control cables etc. the flowmeter shall be at 71 mt elevation in chimney. Approx. weight 35 kgs	Set	1
A.19.0	**STEAM AND WATER ANALYSIS (SWAS): The scope of work includes erection of main system along with the equipments and loose items indicated below, if any, interconnection pipes between cooler, chiller and wet panel, cooling water connection pipes between cooler, chiller and wet panel etc. Commissioning of the system by OEM.**		
A.19.1	1. Sample Handing System: Sampling handling system consisting of: Primary Rack # 1: 01 Nos. Dim.2300(L)x1000(D)x2100(H) in mm) App.overall weight 400 kg, Primary Rack # 2: 01 Nos. Dim.1000(L)x1000(D)x2100(H) in mm) App.overall weight 200 kg, Primary Rack # 3: 01 Nos. Dim.1200(L)x1000(D)x2100(H) in mm) App.overall weight 200 kg, Self Standing Racks # 4(Hot Well Conductivity): 01 No. (App. Dim.800(L)x800(D)x1800(H) in mm) App.overall weight 150 kg., Wet Panel Approx. Size-6300(W)X1600(D)x2115(H) # 5- 1 No. App.weight: 3000 kg., Analyser panel:01 No.(App. Dim.7300(L)x800(D)x2115(H) in mm), 01 No. App.overall weight 2000 kg, Chiller unit:01 No. (App. Dim 2200(L)x1200(D)x1375(H) in mm) and App.Overall weight: 850kg 2. Sampling Sensors, Transmitters and Devices consist of approx.: Specific Conductivity Transmitters and Sensors: 13 Sets, Cation Conductivity Transmitters and Sensors: 10 Sets, pH Transmitters and Sensors: 10 Sets, Dissolved O2 Transmitters and Sensors:8 Sets, Silica Analysers: 03 Sets, Sodium Analysers: 01 Set, Chloride Analysers: 01 Set, Turbidity Transmitters and Sensors: 01 Set, Salinity Analyser- 01 Set, Hydrazine Analyser - 01 Set, Chloride Analyser-01 set, Specific Conductivity Transmitters and Sensors(Hotwell)-2 Nos; Ammonia Analyser-1Set; Temperature Switch-14Nos; Pressure Gauge-23 Nos; Temperature Gauge-23 Nos.; Flow Switch-9 Nos; 3. ACW Pump Discharge Rack - 01 No. Dim.2300(L)x1000(D)x2100(H) in mm) App.overall weight 400 kg, with approx. sensors and instruments as follows: Specific Conductivity Transmitter-1No., Cation Conductivity Transmitter-1No., Specific Conductivity Sensor-1No., Cation	Set	1

Item No.	Description	UOM	Qty
	Conductivity Sensor-1No., Flow Indicator-3Nos., etc. 4. CW Pump Discharge Rack - 01 No. Dim.2300(L)x1000(D)x2100(H) in mm) App.overall weight 400 kg, with approx. sensors and instruments as follows: pH Transmitter-1No., Residual Chlorine Transmitter-1No., Salinit Transmitter-1no., Specific Conductivity Sensor-1No., Specific Conductivity Transmitter-1 No., Various Sensors-4 Nos., Cation Conductivity Sensor-1No., Flow Indicators-5Nos., etc. 5.FILTERED WATER STRG TANK-1 O/L HDR, FILTERED WATER STRG TANK-2 O/L HDR Rack-01 Nos. Dim.1000(L)x1000(D)x2100(H) in mm) App. overall weight 200 kg with approx. sensors and instruments as follows: pH Transmitter-1No., Various Sensor-1No., Flow Indicator-3Nos., etc. 6. Self Standing Racks # 5, 6, 7: 01 Nos. each Dim.700(L)x800(D)x1800(H) in mm) App.overall weight 200 kg,, with approx. quantity of transmitters and sensors as follows: conductivity Transmitters-1 Nos., Conductivity Sensors-1 Nos., Flow Indicators-1 Nos., etc. 7. Self Standing Racks # 8,9,10,11,12,13,14: 01 Nos. each Dim.700(L)x800(D)x1800(H) in mm) App.overall weight 200 kg,, with approx. quantity of transmitters and sensors as follows: pH Transmitters-1 Nos., pH Sensors-1 Nos., Flow Indicators-1 Nos., etc. 10. Self Standing Racks # 15: 01 Nos. each Dim.700(L)x800(D)x1800(H) in mm) App.overall weight 200 kg,, with approx. quantity of transmitters and sensors as follows: pH Transmitters-1 Nos., pH Sensors-1 Nos., Flow Indicators-1 Nos., etc 8. Special cables for sensors between wet and dry panel approx. 1500mtrs, 4. Laying and termination of Power Cables to SWAS Panel and Chiller approx. 50 mtrs		
A.19.2	Void		
A.19.3	A 106 Gr. 2" NB SCH 40 for Cooling water for SWAS includes Tees and bends	Mtrs	140
A.19.4	SS316, 2" NB SCH 40	Mtrs	40
A.19.5	SS304, 2" NB SCH 80	Mtrs	20
A.19.6	Tubing with connectors (SS316 1/4" OD) Between wet and dry panel	Mtrs	420
A.19.7	Table along with chairs	SET	2
A.19.8	Vertical cabinets 1000 x 480 x 2000 mm made of sheet steel (18 gauge sheet thickness) and equipped with safety locks, one shelf 200 x 500 x 200 mm with partitions made of steel.	SET	2
A.20.0	**Erection and Commissioning of VIBRATION MONITORING SYSTEMS**		

Item No.	Description	UOM	Qty
A.20.1.B	Installation of vibration sensors, driver, extension cable with mounting block Approx. Qty-97 nos(2 nos. Vibration sensor X & Y per mounting block), Phase marker sensor, driver, extension cable with bracket - Qty 38 nos, Shaft vibration sensors, driver, extension cable with probe holder - Qty 12 nos. Loop checking using Portable Shaker Table for each vibration sensor and eddy-current sensors. Portable Shaker Table will be provided by BHEL. Instruction sheet will be provided by BHEL. This broadly covers equipments of CER Unit#2, CWPH of Unit#2	Set	1
A.20.2	Junction boxes (24way)	Nos	61
A.20.3	Server PC with monitors accessories along with net work cables (ethernet cables-75m)	Nos	2
A.20.4	Printer	Nos	1
A.21.0	**Simulator-Installation and Commissioning Assistance (Commissioning of system by OEM)**		
A.21.1	LED based rear projection Video wall: DLP cube (1x1) with cube of size 80”-84” with 1600 mm x 1200 mm along with controller-1 set and and other interconnectors like matrix switchers, port splitters and cables like DVI Cables, Video Cables, serial cable, power supply sockets, bezel/frame for the complete LVS video wall, and Mounting stand approx. 1000 mm height / arrangement etc. with overall dimensions of the video wall arrangement as approx. 1600mm(length)x2200mm(height)x964mm{width)	Set	1
A.21.2	Workstation Computers	Nos	12
A.21.3	Server	Nos	4
A.21.4	Printer	Nos	3
A.21.5	Power Distribution Panel (Panel Size - 2200mmx 750mmX 650mm Approx.)	SET	1
A.21.6	Cat-5/Cat-6 Network Cables	Mtrs	300
A.21.7	Power Cables (3Core , BL 3CX2.5SQ.MM CU 1100V SCREENED)	Mtrs	1000
A.21.8	Network Enclosure along with Layer-2 24 (10x/100x) Ports Ethernet switch - 2Nos, firewall, licensed software, etc. (Approx Size 1mX1mX1m)	SET	1
A.21.9	LCD Projector	SET	1
A.22.0	**IP BASED EPABX SYSTEM (PLANT TELEPHONE SYSTEM) Erection by PSSR. Commissioning by OEM**		
A.22.1	Laying of outdoor telecom cable (Jelly field cable)	Mtrs	43000
A.22.2	Laying of indoor telecom cable (PVC cable + conduits)	Mtrs	24000
A.22.3	Laying of FO Cables	Mtrs	15000
A.22.4	Laying of UTP Cables	Mtrs	2000
A.22.5	Laying of Power Cables	Mtrs	1500
A.23.0	**MAIN UPS WITH ACDB & BATTERY**		

Item No.	Description	UOM	Qty
A.23.1	2 X200 KVA UPS parallel redundent comprising of the following tentatively : UPS-1 , UPS 2, Rectifier Panels, Inverter panels, Input Iso. Transformer & SVR panels. Approx. Over all size 9660 mm (L) x 1000 mm(W) x 2240 mm(H) aprox weight 5700 Kg. Accessories like wall mounted Battery isolation JB of approx. size 450mm x 300mm x750mm weight 80 Kg aprox (qty 1 no).Battery tie breaker 400mm x 600mm x 300mm aprox weight 50 kg (qty 2 nos) and other accessories alongwith kit cable 30 mtrs.	set	1
A.23.2	ACDB :over all approx. size 1850 mm(L) x 650 mm(D) x 2100 mm(H) mm; aprox weight 1350 kg.	Nos	2
A.23.3	Uninyvin Cables, size 0000 (109 sq.mm Cu Cable)	Mtrs	1600
A.23.4	Modbus (RS485) cable	Mtrs	400
A.23.5	Uninyvin Cable Termination size 0000 (109 sq.mm Cu Cable)	Nos	12
A.23.6	BHMS aprox size 1000mm x 300mm x 1000mm	Nos	2
A.23.7	UPS BATTERY: Fibre Plated Ni-Cd Battery 1045 AH made up of around 2x295 cells, housed in racks in multi row configuration with inter cell connectors, inter block connectors , inter row connectors, cell mounting insulators, filling of electrolyte 6.6kg/cell, Corrosion Prevention Grease and SS fastners, Each Cell dimension: 238(L) x 209(W) x 405(H).Weight/cell: 24 Kg. Approx without electrolyte with safety apparatus accessories of batteries and test measuring instruments.	set	1
A.23.8	24 V DC Ni-Cd Battery for TG Charger :Rating 560AH 24 V DC. Total cells 19 nos housed in racks with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators, filling electrolyte for each cell 3.5 litres. corrosion prevention crease and SS fastners, Each cell dimension : 157mm x 157mm x 405mm each cell weight 12.50 (without alkaline). along with safety apparatus accessories of batteries and test measuring instruments.	set	2
A.23.9	24 V DC Ni-Cd Battery for SG Charger :Rating 935AH 24 V DC. Total cells 19 nos housed in racks with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators, filling electrolyte for each cell 7.5 litres. corrosion prevention crease and SS fastners, Each cell dimension : 238mm x 209mm x 405mm each cell weight 21.58 (without alkaline). along with safety apparatus accessories of batteries and test measuring instruments.	set	2
A.23.10	SG/TG Charger complete with all accessories (approx. dimension of each charger-1300x800x2200 mm and approx. weight 1600kg) along with DCDB (approx. dim. 1200X800X2200 and approx. weight 1200kg), etc.	Set	2
A.23.11	TG Siemens Charger (approx.120A) complete with all accessories along with DCDB (approx. dim. 1300X800X2200 and approx. weight 1600kg), etc.	Set	2
A.24.0	**Offsite - UPS WITH ACDB & BATTERY**		

Item No.	Description	UOM	Qty
A.24.1	2 X5 KVA UPS parallel redundent comprising of the following tentatively : UPS- 1 , UPS 2, Rectifier Panel, inverter panels, Input Iso. Transformer, wall mounted Battery isolation JB and other accessories like battery tie breakers,etc. (for STP, ETP, Sewage Intake Plant)	Set	3
A.24.2	2 X 10 KVA UPS parallel redundent comprising of the following tentatively : UPS- 1 , UPS 2, Rectifier Panel, inverter panels, Input Iso. Transformer, wall mounted Battery isolation JB and other accessories like battery tie breakers,etc. (for CCTV Plant)	Set	1
A.24.3	PVC FRLS Copper Cable	Mtrs	320
A.24.4	Communication Cable	Mtrs	240
A.24.5	PVC FRLS Copper Cable Termination	Nos	16
A.24.6	UPS BATTERY Ni-Cd Battery made up of around 180 cells, 140AH housed in racks of multi row configuration with inter cell connectors, inter block connectors , inter row connectors, cell mounting insulators, filling of electrolyte for each cell, corrosion prevention grease and SS fastners, Each Cell dimension: 101(L) x 134(W) x 391(H).Cell weight: 9.7 Kg Approx. with safety aparatus accessories of batteries and test measuring instruments.	Set	1
A.24.7	UPS BATTERY Ni-Cd Battery made up of around 90 cells, approx. 94AH housed in racks of multi row configuration with inter cell connectors, inter block connectors , inter row connectors, cell mounting insulators, filling of electrolyte 3 litres/cell for each cell, corrosion prevention grease and SS fastners, Each Cell dimension: 101(L) x 134(W) x 391(H).Cell weight: 9.7 Kg Approx. with safety aparatus accessories of batteries and test measuring instruments.	Set	3
A.24.8	ACDB	Nos	8
A.25.0	**E&C of LOCAL INSTRUMENT ENCLOSURES/RACKS**		
A.25.1	Local Instrument Enclosures (Type - A)-Size: 1450(W) x 1000(D) x 2200 (H)mm; Approximate weight: 700 kg each	Set	12
A.25.2	Local Instrument Enclosures (Type - B)-Size: 1100(W) x 1000(D) x 2200 (H)mm; Approximate weight: 650 kg each	Set	29
A.25.3	Local Instrument Enclosures (Type - C)-Size: 800(W) x 1000(D) x 2200 (H)mm; Approximate weight: 600 kg each	Set	15
A.25.4	Local Instrument Racks (Type - A)-Size: 1400(W) x 650(D) x 2200(H) mm; Approximate weight: 700 kg each	Set	12
A.25.5	Local Instrument Racks (Type - B)-Size: 1100(W) x 650(D) x 2200(H) mm; Approximate weight: 650 kg each	Set	22
A.25.6	Local Instrument Racks (Type - C)-Size: 800(W) x 650(D) x 1600(H) mm; Approximate weight: 600 kg each	Set	6
A.26.0	**LAYING AND TERMINATION OF CABLES**		
A.26.1	**THERMOCOUPLE CABLE**		
A.26.1.1	2 Pair, KX Type TC Extension Cable (1.31mm2) (16 AWG)	Mtrs	19575
A.26.1.2	4 Pair, KX Type TC Extension Cable (1.31mm2) (16 AWG)	Mtrs	12000

Item No.	Description	UOM	Qty
A.26.1.3	6 Pair, KX Type TC Extension Cable (1.31mm2) (16 AWG)	Mtrs	2000
A.26.1.4	8 Pair, KX Type TC Extension Cable (1.31mm2) (16 AWG)	Mtrs	19500
A.26.1.5	2P, Rx type TC Extension Cable (1.31 mm2) (16 AWG)	Mtrs	700
A.26.2	**INSTRUMENTATION CABLE**		
A.26.2.1	OA-2P x 0.5 sqmm	Mtrs	3600
A.26.2.2	OA-4P x 0.5 sqmm	Mtrs	18276
A.26.2.3	OA-8P x 0.5 sqmm	Mtrs	14412
A.26.2.4	I&OA-2P x 0.5 sqmm	Mtrs	21294
A.26.2.5	I&OA-4P x 0.5 sqmm	Mtrs	27893
A.26.2.6	I&OA-6P x 0.5 sqmm	Mtrs	10136
A.26.2.7	I&OA-8P x 0.5 sqmm	Mtrs	21648
A.26.2.8	I&OA-12P x 0.5 sqmm	Mtrs	7200
A.26.3	**CONTROL CABLE**		
A.26.3.1	3 C x 2.5 sqmm	Mtrs	1029
A.26.3.2	5 C x 2.5 sqmm	Mtrs	1800
A.26.3.3	3C X 1.5 sqmm	Mtrs	15831
A.26.3.4	2C X 1.5 sqmm	Mtrs	3600
A.26.4	**TG Special Cables**		
A.26.4.1	PTFE Cable 5C X 1.5 SQ MM	Mtrs	1000
A.26.4.2	PTFE Cable 2PX0.5 SQ. MM	Mtrs	6000
A.26.4.3	PTFE Cable 4P X 0.5 SQ. MM	Mtrs	2000
A.26.4.4	T/C Cable K-Type (2P , 1.3 mm2)	Mtrs	3000
A.26.5	**Other Cables and other items**		
A.26.5.1	CAT 6 UTP Cable	Mtrs	4016
A.26.5.2	Laying of Optic Fiber cable	Mtrs	16631
A.26.5.3	HDPE Conduits for laying OFC cables	Mtrs	6000
A.26.5.4	Splicing of Optical Fibre Cable	Nos	146
A.26.5.5	Network enclosures with ethernet switches as applicable	Set	6
A.27.0	**Installation of CABLE TRAYS with accessories**		
A.27.1	50 mm Perforated Trays without Cover	Mtrs	1500
A.27.2	100 mm Perforated Trays without Cover	Mtrs	1500
A.28.0	**E&C of JUNCTION BOXES**		
A.28.1	12 way JB	Nos	14
A.28.2	24 way JB	Nos	23
A.28.3	36 way JB	Nos	30
A.28.4	48 way JB	Nos	6
A.28.5	64 way JB	Nos	6
A.28.6	Temperature Transmitter Junction Box-Type A Approx. Size: (800mm(W) X 500mm(D) X900mm(H)) Weight: Approx: 400kg	Nos	21
A.28.7	Temperature Transmitter Junction Box-Type B Approx. Size: (800mm(W) X 500mm(D) X600mm(H)) Weight: Approx: 350kg	Nos	11

Item No.	Description	UOM	Qty
A.28.8	Temperature Transmitter Junction Box-Type C Approx. Size: (800mm(W) X 500mm(D) X400mm(H)) Weight: Approx: 320kg	Nos	42
A.29.0	**IMPULSE PIPES, FITTINGS, MANIFOLDS AND ACCESSORIES.**		
A.29.1	ASTM A106 Gr C - 1/2" NB SCH 160-CS	Mtrs	1900
A.29.2	ASTM A106 Gr C - 1/2" NB SCH 80-CS	Mtrs	7100
A.29.3	ASTM A106 Gr C - 3/4" NB SCH 80-CS	Mtrs	5600
A.29.4	ASTM A335 P22 - 1/2" NB SCH XXS-Alloy Steel	Mtrs	100
A.29.5	Void		
A.29.6	A335 P22 1/2" NB SCH 160	Mtrs	750
A.29.7	ASTM A106 GR C 1" NB SCH 80	Mtrs	120
A.29.8	ASTM A213 TP316H, 1/2" Sch. 160	Mtrs	900
A.29.9	A213 TP316H - 3/4" NB SCH 160	Mtrs	700
A.29.10	A213 TP316H - 3/4" NB SCH 80	Mtrs	1000
A.29.11	ASTM A335 P22 - 3/4" NB SCH 80	Mtrs	1100
A.30.0	CPVC Pipes ASTM D1784 CPVC Pipe(IndustriaL Grade)-1/2" NB SCH 80	Mtrs	1200
A.31.0	**E&C OF LARGE VIDEO SCREEEN SYSTEMS**		
A.31.1	LED based rear projection Video wall: DLP cubes Video wall in 5x1 matrix with individual cube of size 80”-84” with 1600 mm x 1200 mm along with controller- 1 set and DLP cube (1x1) with cube of size 80”-84” with 1600 mm x 1200 mm along with controller-1 set and other interconnectors like matrix switchers, port splitters and cables like DVI Cables, Video Cables, serial cable, power supply sockets, bezel/frame for the complete LVS video wall, and Mounting stand approx. 1200 mm height / arrangement etc. with overall dimensions of the complete video wall arrangement as approx. 9944.6 mm(chord)x2400mm(height)x964mm{width)	Set	1
A.31.2	43/55" LED TV with accessories	SET	9
A.32.0	**E&C of HMI System Package**		
A.32.1	Operator Station	Nos	17
A.32.2	Alarm Station (ALS)/SOE/SER station	Nos	1
A.32.3	Engineering Activity Station (EAS):	Nos	4
A.32.4	INFO / Historian station and Buffer Station for INFO/Historian station	Nos	4
A.32.5	Backup Station (BU)	Nos	3
A.32.6	OPC Server	Nos	2
A.32.7	COLOR LASER JET AUTO DUPLEX PRINTER –A4	Nos	6
A.32.8	B/W LASER JET AUTO DUPLEX PRINTER –A4	Nos	7
A.32.9	COLOR LASER JET AUTO DUPLEX PRINTER -A3	Nos	2
A.32.10	MULTIFUNCTION PRINTER (SCANNER, COPIER CUM PRINTER) - A3	Nos	1
A.32.11	LINE IMPACT DOT MATRIX PRINTER	Nos	3
A.32.12	Layer 2 (Level 2) Access Switches	Nos	14
A.32.13	Layer 2 (Level 1) Access Switches	Nos	2

Item No.	Description	UOM	Qty
A.32.14	Layer 3 switch	Nos	2
A.33.0	**STATION LAN / MIS SYSTEM installation and commissioning including media converter, LIU, router, cabling etc. at different locations**		
A.33.1	MIS Server along with mini UPS	Nos	2
A.33.2	Workstations along with mini UPS	Nos	7
A.33.3	MIS Clients along with mini UPS	Nos	51
A.33.4	B/W LASER JET AUTO DUPLEX PRINTER –A4	Nos	26
A.33.5	MONOCHROME LASERJET PRINTER CUM COPIER (A3)	Nos	10
A.33.6	MULTIFUNCTION PRINTER (SCANNER, COPIER CUM PRINTER) - A3	Nos	1
A.33.7	Station LAN router cum firewall with IPS	Nos	2
A.33.8	Network switches	Nos	1
A.34.0	**E&C of HMI System (Offsite Packages)**		
A.34.1	Operator Station	Nos	2
A.34.2	Engineering Activity Station (EAS)	Nos	4
A.34.3	B/W Laser Jet Auto Duplex Printer A4	Nos	2
A.34.4	LINE IMPACT DOT MATRIX PRINTER	Nos	2
A.35.0	**STRUCTURAL MATERIALS & MISCELLENEOUS ITEMS**		
A.35.1	ISMC 100, ANGLE 50X50X6 & 2.5MM THICK Plates	MT	6
A.35.2	Duct Tray - 60x60x1000 mm	Mtrs	210
A.35.3	Duct Tray - 100x180x1000 mm	Mtrs	110
A.35.4	Duct Tray - 100x250x1000 mm	Mtrs	110
A.35.5	Assembly and Installation of Mounting frames with loose supplied prefabricated materials like slotted angles, channels, etc.	Nos	21
A.36.0	**VOID**		
A.37.0	**COMPUTER FURNITURES**		
A.37.1	Unit Control Desk (9 Sections) including fixing of power Sockets, MCBs, ethernet switches hardware etc (along with Chairs) (Approx. overall dimension 2397mm(D) x 10056mm(W) x 750mm(H))	Set	1
A.37.2	2 Section Desk (overall Approx. dimension 950mm(D)x2000mm(W)x1650mm(H)) including fixing of power Sockets, MCBs, ethernet switches hardware etc (along with chairs)	Set	7
A.37.3	1 Section Desk (overall Approx. dimension 950mm(D)x1000mm(W)x1650mm(H)) including fixing of power Sockets, MCBs, ethernet switches hardware etc (along with chairs)	Set	1
A.37.4	Computer Table (overall Approx. dimension 750mm(D)x1500mm(W)x735mm(H)) along with chairs	Set	31
A.37.5	Printer Table (overall Approx. dimension 650mm(D)x900mm(W)x740mm(H))	Set	11
A.37.6	Lockers (overall Approx. dimension 457mm(D)x380mm(W)x1830mm(H))	Set	24

Item No.	Description	UOM	Qty
A.37.7	Almirah (overall Approx. dimension 480mm(D)x910mm(W)x1980mm(H))	Set	11
A.37.8	Printer Rack (overall Approx. dimension 950mm(D)x1000mm(W)x1500mm(H))	Set	5
A.38.0	**COMMISSIONING OF THE FOLLOWING**		
A.38.1	Commissioning of Transducers- Removal and recalibration of Power, Voltage, Current, Frequency out put 4-20 mA	Nos	25
A.39.0	**VOID**		
A.40.0	**VOID**		
A.41.0	**CCTV, INTRUSION DETECTION SYSTEM AND ACCESS CONTROL SYSTEM**		
A.41.1	Laying and Termination of 3CX2.5Sqmm	Mtrs	5000
A.41.2	Laying and Termination of 3CX1.5Sqmm	Mtrs	23000
A.41.3	Laying of PVC Conduit and casing	Mtrs	4000
A.41.4	Installation of PTZ Cameras	Nos	285
A.41.5	Installation of Panel of weight approx. 500kg	Nos	1
A.41.6	Installation of 32"/40"/42" Monitor	Set	8
A.41.7	Installation of 6 Mtrs GI Pole	Nos	40
A.41.8	Junction Boxes	Nos	200
A.41.9	Cable Trays of size 50X25mm	Mtrs	5000
A.41.10	Laying of HDPE Conduit	Mtrs	20000
A.41.11	Mounting of Electromagnetic lock and readers	Nos	36
A.42.0	**HMI Package to be installed at TANGEDCO HQRS comprising of PCs with mini UPS - approx. 2Nos, , Printers-approx. 4 Nos., their related furniture etc. and their interconnectivity**	Set	1
A.43.0	**PADO**		
A.43.1	Operator Station/Server	Nos	4
A.43.2	B/W LASER JET AUTO DUPLEX PRINTER –A4	Nos	2
A.43.3	COLOR LASER JET AUTO DUPLEX PRINTER -A3	Nos	1
A.44.0	**HART MANAGEMENT SYSTEM**		
A.44.1	HART Management System Panel of dimensions 600 mm L x 600 mm D x 2067 mm H	Set	4

Item No.	Description	UOM	Qty
A.45.0	LAB INSTRUMENTS - To be demonstrated and handing over to Customer. (This includes shifting of the instruments and providing necessary assistance to the OEM for commissioning and demonstrating the instruements). Indicative list of lab isntruments is provided here: LAB INSTRUMENTS - To be demonstrated and handing over to Customer. (This includes shifting of the instruments and providing necessary assistance to the OEM for commissioning and demonstrating the instruments). Indicative list of lab instruments is provided here: Electronic Test Bench -1no., Pneumatic Test Bench-1no., Portable Calibrator for Vacuum-1no., Portable Digital Multimeter (4 ½ digit)-12 Nos., Digital Multimeter (Table Mounting Type)-2nos., U-Tube Manometer-2nos., Inclined -Tube Manometer-2nos., Test Manometer-2nos., Dead Weight Tester-1no., Vacuum Tester-1 no., Digital Manometer-1no., Standard Pressure Gauges-2nos., Microprocessor based Fluidized Temperature Bath-1no., Low, Medium & High temp Portable Dry block type Calibrator -1no., RCL Meter-1no., In Circuit Tester-1no., Function Generator-1No., Digital Oscilloscope-1No., Tachometer-2nos., Soldering iron-3nos., Solder Sucker-2nos., Soldering Desoldering station-2Nos., Potentiometer/Rheostat-1o Nos., AC Thermometery Bridge-1No., Mercury Thermometers-2Nos., Flow meter Calibrator-3 Nos., Stop Watch-2Nos., Digital Thermograph/Hygrometer-1No., Portable Flue gas Analyser-1No., Aneroid Barometer-1No., Tool maker clamp jaw-1 No., Hand operated wire wrap tool-1No., Trimmer & Alignment Tool Kit-1No., Magnetic screw driver-1 No., SS & copper tube cutter/blender-1No., Standard tool box-6 Nos., Coil winding machine-1No., Electrically operated wire wrap-1 No., Panel wiring tool kit-5Nos., mV Calibrator-1 No. (Table Mounted), 3Nos. Portable, mA Calibrator- 2 No. (Table Mounted), 6Nos. Portable, Thermocouple Calibrator-1 No. (Table Mounted), 2Nos. Portable, RTD Calibrator-1 No. (Table Mounted), 1No. Portable, Pressure & Differential Pressure Calibrator-2 No. (Table Mounted), 2 No. Portable, Vacuum Calibrator-1 No. (Table Mounted), Multi-Function Calibrator-1 No., Pressure & Vacuum Air Pump-1No., Digital Insulation Tester-2No., Sound Level Monitor-2No., Air Set-2 No., Portable Electro-Pneumatic Calibrator-4 Nos., Portable Digital/Analogue Vibration Meter-Digital-2Nos., Analogue-1No., VIBRATION/ SHOCK PULSE ANALYSER cum Data Collector cum Balancer- 1No., Decade Resistance Box-3 Nos. Analogue, 3Nos. Digital, LAN/ Coaxial Cable Meter/ Tester-2Nos., Portable Ultrasonic Flow meter-2Nos., EARTH/Ground RESISTANCE TESTER-2Nos., PORTABLE INFRARED RADIATION THERMOMETERS-1No., Thermocouple Test Furnace-1No., Microprocessor based Portable H2 Gas Analyser-1No., Fiber Optic Testing Tool Set-2Nos., Industrial portable Vacuum Cleaner-6Nos., Tong Tester-2Nos., Averaging Pitot Tube-2Nos., Stroboscope-1No., Auto Transformer-(Single	SET	1

Item No.	Description	UOM	Qty
	Phase-2Nos., 3Phase-2Nos.), Test Temp Dedector – Test RTD, Test K Type Thermocouple & Test T Type Thermocouple-2Nos., Overhead projection Board (Interactive White Board)-2Nos., Projector with white board.-1No., Portable pH Calibrator/Simulator-1No., Oil Condition Monitor-1No., Logic Probe-1No., Marker Printers-1No., DC Regulated Power Supply-4Nos., Digital Camera-2Nos., Digital video camera with in built projector-1No., Computer aided Callibration system with one no. OWS, Printer and Complete Software-1No., PORTABLE INFRARED RADIATION THERMOGRAPH (IR Imaging device & Camera)-1No., Grinding Wheel-1No., Frequency Counter-1No., Portable Conductivity Meter-1No., Vibration Pick Up tester-1No., 230/240 VAC Single phase stabilized supply unit-3Nos., Continuity Tester-6Nos., Optical time Domain reflectometer-2Nos.		
B.	**BHEL-TRICHY SCOPE**		
B.1.0	**Fuel Oil System**		
B.1.1	Mass flow meter with mounting flanges, electronics amplifier box, inter connecting cabling, etc.	Set	3
B.1.2	Pressure Gauges and Differntial Pressure Gauges	Nos	47
B.1.3	Temperature Indicator	Nos	6
B.1.4	Pressure Switches	Nos	23
B.1.5	FSSS Local Oil Gun Maintenance Switch Box	Nos	18
B.1.6	H.E.A Exciter box 240 V AC alongwith retractor assembly 240 V AC solenoid, flexible spark rod 133 inch, spark top, flexible cable asembly 3 mtr long, SS hose 6.35mmx1000mmm, Air Filter Regulator 1/4 inch etc.	Set	16
B.1.7	Flame Scanner Head Assembly consisting fibre optic cable L130" lense barrel, flame processor module, Flame module, pigtail cable, pico fuse, card extender module, power supply module, 6 way JB, etc.	Set	32
B.1.8	Microprocessor based flame scanner amplifier consisting of 19" racks of size 482X263X134(WXDXH) to be mounted in flame scanner panel and interconnections	Set	8
B.1.9	Level Gauge	Nos	2
B.1.10	Temperature Transmitter	Nos	2
B.2.0	**ACOUSTIC STEAM LEAK DETECTOR**		
B.2.1	ACOUSTIC STEAM LEAK DETECTOR system consisting of :1. BHELSonic System Panel Assembly and computer with monitor panel size 800mmx2315mmx750mm and app. weight-200kg 2. ASLD sensor assembly -consisting of approx. 30 Nos. Sonic Tube Assembly , 32 nos. Sensor Assembly, 30 Sets. of Field Amplifier Box, 30 Sets Field Amplifier Module, Sensor Pigtail Cable 450m etc.	Set	1
B.3.0	**FURNACE CCTV SYSTEM**		

Item No.	Description	UOM	Qty
B.3.1	High Temperature Furnace Camera CCTV head assembly with advance retract mechanism and Local Control Unit panels (800mmx1000mmx300mm) with inter connecting pipes, Limit Switches air filter regulators, SS hose mounted at boiler 45 M (approx.) elevation. Video Cables, Remote Control Box (Approx. Dim.630 mm x500 mmx 500 mm, Approx. Wt: 18kg), with 24" monitor and accessories at CCR, 40" monitor of roof hanging type (approx. dim: 911mmx581mmx189mm and approx. wt: 15 kg. & Multiplexer, etc.	Set	4
B.4.0	**PNEUMATIC POWER CYLINDERS**		
B.4.1	Pneumatic Power Cylinders with Position Transmitters controlled from SADC (App.Weight 15 kg each)	Set	116
B.4.2	Pneumatic Power Cylinders with SMART Positioners controlled from DDCMIS (App.Weight 50kg)	Set	16
B.4.3	Cold Air Dampers Actuator with SMART positioner alongwith linkage rod	Set	7
B.4.4	Hot Air Regulating Dampers Actuator with SMART positioner alongwith linkage rod	Set	7
B.4.5	Dynavane Filter Pressure Control Damper with SMART positioner	Set	1
B.5.0	**GRAVIMETRIC FEEDER PANEL**		
B.5.1	Wired Remote Control Panel for GFC Size 1200 x 2315 x 600 and Wt.300 kg	Nos	7
B.5.2	Feeder Coal flow monitor assembly mounted with electronics	Set	7
B.6.0	**STEAM/WATER/PULVERIZER/AIR/FLUE GAS LINE INSTRUMENTS**		
B.6.1	Pressure Indicators AND Differential Pressure Indicators	Nos	39
B.6.2	Pressure Switches, Differential Pressure Switches, Differential Pressure Switches High/Low	Nos	48
B.6.3	Temperature Indicator	Nos	26
B.6.4	K-Type MTM Thermocouple 8MM OD & 8 M DUPLEX	Nos	3
B.6.5	K-Type MTM Thermocouple 8MM OD & 10 M DUPLEX	Nos	22
B.6.6	K-Type MTM Thermocouple 8MM OD & 12 M DUPLEX	Nos	32
B.6.7	K-Type MTM Thermocouple 8MM OD & 14 M DUPLEX	Nos	22
B.6.8	K-Type MTM Thermocouple 8MM OD & 16 M DUPLEX	Nos	19
B.6.9	K-Type MTM Thermocouple 8MM OD & 18 M DUPLEX	Nos	32
B.6.10	K-Type MTM Thermocouple 8MM OD & 20 M DUPLEX	Nos	36
B.6.11	K-Type MTM Thermocouple 8MM OD & 22 M DUPLEX	Nos	75
B.6.12	K-Type MTM Thermocouple 8MM OD & 24 M DUPLEX	Nos	92
B.6.13	K-Type MTM Thermocouple 8MM OD & 26 M DUPLEX	Nos	49
B.6.14	K-Type MTM Thermocouple 8MM OD & 28 M DUPLEX	Nos	19
B.6.15	K-Type MTM Thermocouple 8MM OD & 30 M DUPLEX	Nos	13
B.6.16	Level Switches High/Low, etc.	Nos	32
B.6.17	ERV Controller with Pressure Switch (SH/RH) App.Dimension(mm): 400(W)x350(H)x190mm; App.Wt: 50 kg	Set	2
B.6.18	Flow Switch	Nos	7

Item No.	Description	UOM	Qty
B.6.19	Flow Element	Nos	12
B.7.0	**LAYING AND TERMINATION OF CABLES (PVC/PTFE,FRLS/HRPVC CABLES FOR SCANNER, MILL FEEDER, AC CONTROLS AND INSTRUMENTATION)**		
B.7.1	FLAME SCANNER CABLE-P/O SHIELDED-Unarmoured 2P x 1.31 sq mm cable	Mtrs	10000
B.7.2	4P X 0.5 SQMM O/A SHIELDED INST.CABLE, Armoured	Mtrs	7500
B.7.3	8P X 0.5 SQMM O/A SHIELDED INST.CABLE, Armoured	Mtrs	83500
B.7.4	12P X 0.5 SQMM O/A SHIELDED INST.CABLE, Armoured	Mtrs	15000
B.7.5	2P X 1.5 SQMM P/O SHIELDED INST.CABLE, Armoured	Mtrs	10000
B.7.6	2P X 0.5 SQMM P/O SHIELDED INST.CABLE, Armoured	Mtrs	2000
B.7.7	4P X 0.5 SQMM P/O SHIELDED INST.CABLE, Armoured	Mtrs	4000
B.7.8	8P X 0.5 SQMM P/O SHIELDED INST.CABLE, Armoured	Mtrs	11000
B.7.9	12P X 0.5 SQMM P/O SHIELDED INST.CABLE, Armoured	Mtrs	6000
B.7.10	2P X 0.5 SQ. MM P/O FIRE SURV.INST.CABLE	Mtrs	1000
B.7.11	4P X 0.5 SQ.MM PTFE INST. CABLE - G, Armoured	Mtrs	2500
B.7.12	8P X 0.5 SQ.MM PTFE INST. CABLE - G, Armoured	Mtrs	500
B.7.13	4P X 0.5 SQ.MM PTFE INST. CABLE - F, Armoured	Mtrs	500
B.7.14	2P X 1.31 SQ.MM PTFE EXTENSION CABLE, Braided	Mtrs	5800
B.7.15	4P X 1.31 SQ.MM EXTENSION CABLE-KX, Armoured	Mtrs	2,500
B.7.16	12P X 1.31SQ.MM EXTENSION CABLE-KX, Armoured	Mtrs	3,240
B.7.17	HEAT FLUX SENSOR CABLE, 2P X 0.5 SQ. mm	Mtrs	1500
B.7.18	4P X 0.5 SQ. MM O/A FIRE SURV.INST.CABLE	Mtrs	4,000
B.7.19	8P X 0.5 SQ. MM O/A FIRE SURV.INST.CABLE	Mtrs	2,000
B.8.0	**CABLE TRAY**		
B.8.1	PERFORATED CABLE TRAY-50 MM WIDTH	Mtrs	1100
B.8.2	PERFORATED CABLE TRAY-100 MM WIDTH	Mtrs	2530
B.8.3	PERFORATED CABLE TRAY-150 MM WIDTH	Mtrs	1700
B.9.0	**JUNCTION BOXES**		
B.9.1	24 WAY FRP JUNCTION BOX	Nos	102
B.9.2	48 WAY FRP JUNCTION BOX	Nos	40
B.9.3	72 WAY FRP JUNCTION BOX	Nos	15
B.9.4	FLAME PROOF JUNCTION BOX - 24 WAY	Nos	3
B.9.5	FLAME PROOF JUNCTION BOX - 48 WAY	Nos	38
B.9.6	FLAME PROOF JUNCTION BOX - 72 WAY	Nos	27
B.9.7	FRP JUNCTION BOX - DIN RAIL MOUNTED 6TT	Nos	10
B.10.0	**MISCELLENEOUS RACKS/ENCLOSURES/PANELS**		
B.10.1	Local Instrument Enclosures with Junction Boxes, App. Size: (630-1250)mm (L) x800mm(D) x2300mm(H)	Set	13
B.10.2	Local Instrument Racks with Junction Boxes, App. Size: (1010-1330)mm (L) x800mm(D) x 2150mm(H)	Set	4
B.10.3	HWL-1&2 and MEF Controller JB App. Size: 400x500x210 (mm) and App.Wt: 50 kg	Nos	3
B.10.4	HWL-1&2 and MEFCV-Skid Instrumentation	Set	1

Item No.	Description	UOM	Qty
B.10.5	HP Bypass Valve-Skid Instrumentation	Set	1
B.11.0	**HARDWARES FOR TUBING**		
B.11.1	**TUBES**		
B.11.1.1	1/4" Air Filter Regulators (for mill system)	Nos	8
B.11.1.2	1" Air Filter Regulators (for SADC System)	Nos	9
B.11.1.3	Purge Meter cum DP Regulator	Nos	15
B.11.1.4	1" OD Cu TUBE	Mtrs	35
B.11.1.5	1/4" OD Cu TUBE	Mtrs	2700
B.11.1.6	3/4" OD Cu TUBE	Mtrs	20
B.11.1.7	3/8" OD SS TUBE	Mtrs	100
B.11.1.8	1/4" TEFLON HOSE- 2 METER PER PIECE	Nos	90
B.11.1.9	1" TEFLON HOSE- 3 METER PER PIECE	Nos	5
B.11.1.10	1/2" TEFLON HOSE- 1 METER PER PIECE	Nos	15
B.11.2	**SEAMLESS PIPES**	-	-
B.11.2.1	PIPE OD 21.3 X 4.78 SA335P22-1/2" SCH.160	Mtrs	120
B.11.2.2	PIPE OD 21.3 X 3.73 SA335P22-1/2" SCH.80	Mtrs	100
B.11.2.3	PIPE OD 21.3 X 3.73 - SA106GRB-1/2" SCH.80	Mtrs	85
B.11.2.4	PIPE OD 21.3 X 4.78 - SA106GRB-1/2" SCH.160	Mtrs	60
B.11.2.5	PIPE OD 21.3 X 7.47 - SA335P22-1/2" SCH.XXS	Mtrs	25
B.11.2.6	PIPE OD 26.7 X 3.91 - SA335P22-3/4" SCH.80	Mtrs	400
B.11.2.7	PIPE OD 26.7 X 3.91 - SA106GRB-3/4" SCH.80	Mtrs	850
B.11.2.8	PIPE OD 33.4 X 4.55 - SA106GRB-1" SCH.80	Mtrs	1280
B.12.0	**MISCELLENEOUS ITEMS**		
B.12.1	Structural Steel for fabrication of Supports consisting of angles, channels (ANGLE 50X50X6-IS2062E250A, CHANNEL 100X50-IS2062E250A, FLAT 50X6-IS2062GRA etc)	MT	13
B.12.2	GI Pipe 1/2 inch	Mtrs	1115
B.13.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		
B.13.1	Heavy Duty Limit Switches for Burner Tilt Shear Pin Failure Indication Purpose	Nos	28
B.13.2	Motor Operated Valves (MOV) Actuators (On/Off, Inching etc.) in Various Applications	Nos	83
B.13.3	Electric Actuators for Various Dampers (Open/Close, Regulating, Inch)	Nos	13
B.13.4	Pneumatic Actuators for Various Dampers(Open/Close)	Nos	31
B.13.5	Limit Switches (Cabling and Checking) for manually operated dampers	Nos	7
B.13.6	Solenoids (different ratings) of Pneumatic Valves of Various applications - tubing, Cabling & Commissioning	Nos	276
B.13.7	Burner Tilt Shear Pin failure indication junction box App.Dimension: 280(H)x600(L)x200(D): weight 12 kg each	Nos	4

Item No.	Description	UOM	Qty
B.13.8	Calibration/Commissioning of Gravimetric Feeder Comprising of Feeder C&I Equipment like motion monitor sensor, micro switches, etc. along with Feeder Integral Cabinet of App.Size 600x750x350 and Wt.75 kg, etc.	Set	7
B.14.0	**EARTHING MATERIALS**		
B.14.1	Earth Flat (50x6)	Mtrs	125
B.14.2	Earth Wire 1.219 mm GI	Mtrs	350
C.	**BHEL-PIPING CENTRE SCOPE OF SUPPLY**		
C.1.0	**Local Instruments**		
C.1.1	Pressure Gauges	Nos	147
C.1.2	Temperature Gauges	Nos	132
C.1.3	Level Gauge	Nos	8
C.1.4	PIPE OD 21.3 X 3.73SS TP304H,EP AT SITE (SS 1/2 INCH SCH 80)	Mtrs	40
C.1.5	PIPE OD 21.3 X 3.73SA106GRC,EP AT SITE (CS 1/2 INCH SCH 80)	Mtrs	250
C.1.6	PIPE OD 21.3 X 4.78 SA106GRC,EP AT SITE (CS 1/2 INCH SCH 160)	Mtrs	200
C.1.7	PIPE OD 21.3 X 7.47SA106GRC, EP AT SITE (CS 1/2 INCH SCH XX)	Mtrs	100
C.1.8	PIPE OD 21.3 X 3.73SA335P22,EP AT SITE (AS 1/2 INCH SCH 80)	Mtrs	50
C.1.9	PIPE OD 21.3 X 7.47- SA335P22,EP AT SITE (AS 1/2 INCH SCH XX)	Mtrs	70
C.1.10	Averaging Pitot Tube	Set	2
C.2.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		
C.2.1	Control Valves - for LP Start Up Systems & SCAPH Sysyems - including Air Filter Regulators, Positioners, Testing upto DCS	Set	8
C.2.2	MOV Actuators for SCAPH, CW Aux Steam,etc	Nos	7
C.3.0	**Instrument Air and Service Air Piping**		
C.3.1	PIPE NB 15X 3.2 SCREW&SOCKETED IS1239 GAL (1/2 INCH)	Mtrs	13655
D.	**BHEL-RANIPET SCOPE**		
D.1.0	**OPACITY MONITOR (Installation and Commissioning)**		
D.1.1	Opacity Monitoring System consisting of Sender/Receiver/Ref/Control Unit 1 No. each, 5 Metre Slave wire cable-1 No., Purge Air Blower with filter-1 No., Power JB-1 No., Weather Hood Cover for Purge Air Blower JB-1 No.Fully auto. Electric Operated Fail Safe Shutter-2 Nos., Differential Pressure Switch-2 Nos., Mounting Flange With Pipe - 2 Nos., Weather Hood Cover for Sender/Receiver Units - 2 Nos., Weather Hood Cover for Power JB-2 Nos. & Purge Air Hose	Set	4
D.2.0	**AUTOMATIC LEAKAGE CONTROL SYSTEM-Air Pre Heater**		
D.2.1	Automatic Leakage Control System consisting of : ALCS DCS panel 750x750x2067 mm. App. Wt.300 kg-1No; ALCS Drive Control Panel 800mm(W)X1000mm(H)X400mm(W) App.Wt. 100 kg-6Nos., ALCS Controllers, sensor electronics with enclosures interfacing box, accessories (48 kg) and interconnecting cables 6-sets	Set	1
D.3.0	**Instruments of APH/Fans/Gates & Dampers**		

Item No.	Description	UOM	Qty
D.3.1	Pressure Switches	Nos	8
D.3.2	RTD	Nos	62
D.3.3	Temperature Gauge	Nos	28
D.3.4	Flow Indicating Switch	Nos	4
D.3.5	Thermocouple Assembly	Nos	48
D.3.6	On/Off Switch Box including light assembly and interconnecting heat resistant cable	Set	2
D.3.7	Pressure Gauges	Nos	2
D.3.8	Pressure Gauge with Needle Valve	Nos	12
D.3.9	Angular Position Transmitters-For FD/ID/PA/SA Fans	Nos	6
D.3.10	Pressure Switches	Nos	10
D.3.11	Go Switch	Nos	10
D.3.12	Start Stop Push Buttons	Nos	2
D.4.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		
D.4.1	Electric Actuators for Various Dampers	Nos	51
D.4.2	Pneumatic Actuators for Various Dampers	Nos	20
D.4.3	Solenoid Valves APH	Nos	2
D.4.4	Filter Regulator Lubricator	Nos	2
D.4.5	Lub Oil Skids for Air Preheater: The scope of work includes removal of instruments, calibration, re-fixing, checking cable connection from JB to instruments etc. The app. Quantity of instruments for each skids given below: Pressure Gauges-2 Nos. Temperature Gauges-2 Nos., Flow Switches-2 Nos, Commissioning of LT Drives	Set	4
D.4.6	Fan Motor Bearing Temperature Indicators for all fans (Removal, Calibration and re-fixing only)	Nos	24
D.4.7	Fan Motor Bearing/Winding RTDs (Checking of healthiness only)	Nos	72
D.4.8	Lub Oil Skids for FD Fans: The scope of work includes removal of instruments calibration, re-fixing, checking cable connection from JB to instruments etc. The approximate quantity of instruments is: Level transmitters -1 Nos. Temperature Sensing Elements: -4 Nos, Temp. Gauge - 1 No, DP Transmitter - 1 No., Pr. Gauge-4 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 01 No., Level Gauge-1 No, Commissioning of LT Drives	Set	2
D.4.9	Lub Oil Skids for ID Fans: The scope of work includes removal of instruments for calibration, refixing, checking cable connection from JB to instruments etc. The approximate quantity of instruments is: Level transmitters-2 Nos. Temperature Elements - 15 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Gauge-1No.,Pr. Gauge-6 Nos, Pr. Transmitters-3 Nos, Flow Indicator with flow transmitters - 03 Nos., Level Gauge-1 No, Commissioning of LT Drives	Set	2

Item No.	Description	UOM	Qty
D.4.10	Lub Oil Skids for PA Fans: The scope of work includes removal of instruments for calibration, refixing, checking cable connection from JB to instruments etc. The approximate quantity of instruments is: Level transmitters-2 Nos Temperature Elements- 4 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Gauge-1 No., Pr. Gauge- 4 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 01 No, Level Gauge-1No, Commissioning of LT Drives	Set	2
D.5.0	**VOID**		
E	**BHEL-HYDERABAD SCOPE**		
E.1.0	**DRIVE TURBINE INSTRUMENTS**		
E.1.1	Pressure Gauges	Nos	100
E.1.2	Differential Pressure Gauges	Nos	8
E.1.3	Pressure Transmitters & DPT	Nos	90
E.1.4	Pressure Switches	Nos	6
E.1.5	RTDs with Thermowell	Nos	36
E.1.6	Chromel alumel Type Thermocouple	Nos	30
E.1.7	Level Gauges (Reflex Type)	Nos	2
E.1.8	Level Transmitters (Guide Wave Radar Type, top mounted)	Nos	4
E.1.9	Speed Measuring Loop with probe	Nos	12
E.1.10	Proximeter Units, Local Field Cable etc.	Set	12
E.1.11	Position Transmitters	Nos	4
E.1.12	Temperature Gauges	Nos	40
E.1.13	E/P Transducers	Nos	4
E.2.0	**DRIP PUMP/CWP/TDBFP/CEP/MDBFP INSTRUMENTS**		
E.2.1	Temprature Transmitters	Nos	37
E.2.2	Temperature Gauges	Nos	59
E.2.3	Pressure Gauge and Differential Pressure Gauge	Nos	76
E.2.4	Pressure Transmitters & DPT	Nos	52
E.2.5	Flow Transmitters	Nos	2
E.2.6	Speed Transmitter/ Reverse Rotation Indicators	Nos	4
E.2.7	Level Indicator	Nos	4
E.2.8	Temperature Elements (RTDs)	Nos	180
E.2.9	Level transmitter	Nos	2
E.2.10	Speed Transmitter	Nos	2
E.2.11	Temperature Indicator	Nos	11
E.2.12	Axial Probe	Nos	1
E.2.13	Differential Pressure Indicator	Nos	1
E.2.14	Key Phasor	Nos	1
E.3.0	**HEAT EXCHANGERS (LP & HP Heaters) & DEAERATORS**		
E.3.1	Pressure Gauges	Nos	9
E.3.2	Level Gauges	Nos	10
E.3.3	Level Switches	Nos	3
E.3.4	Thermowell	Nos	11

Item No.	Description	UOM	Qty
E.3.5	Bimetallic Temperature Gauges	Nos	8
E.4.0	**PULVERSING SYSTEM – E&C**		
E.4.1	Temperature Elements -Planetary Gear Box	Nos	42
E.4.2	Level Switches (Mill Seal Air)	Nos	7
E.4.3	Junction Boxes (48 Way)	Nos	7
E.4.4	MDV Solenoids with Manifolds and tubing	Nos	14
E.5.0	**PANEL/FIELD MOUNTED INSTRUMENTS**		
E.5.1	TSI System for BFP Drive Turbine and gear box consisting of the following: Configuration of Laptop with software-1 No., Monitor Rack with Modules (to be mounted on CWW panel) app. Wt. 40 kg per rack-1 Set, relative shaft vibration sensor probes 8mm reverse mounted Turbine and gear box-8 Nos, Axial Displacement Probes-3 Nos., Eccentricity Probe-1 No., Zero Speed Probe - 1 No., Key phasor-1 No., Bearing housing vibration Probes-4 Nos., Differential Expn. Probe -1 No., Casing Expansion-1 No., with probe extension cables-18 Nos., Probe drivers for VIBR-17 Nos., Driver Housing -12 No., JB - 3 Nos., Flexible conduits-150 Mtr., Cable seal, Cable connectors, Mounting brackets for vibration/differential exp/brg housings, RS485 cable with connector for DCS 35 Mtr long etc and calibration kit.	Set	2
E.5.2	Temperature Indicators of Heat Exchangers, etc. (Removal, Calibration & Refixing only)	Nos	8
E.6.0	**LOCAL GAUGE BOARD (LGB) / LOCAL I NSTRUMENT RACK (LIR) (including removal, calibration and re-fix ing of LGB mounted instruments/JB)**		
E.6.1	LGB (LGB -1)Assembly for Feed Water Service for TDBFP/MD BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs. Approximate Size 1100 x900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Pressure Gauge: 4 Nos.DP Gauges: 2 Nos.Temperature Gauges: 2 Nos.	Set	3
E.6.2	LGB (LGB-2) Assembly for SW & Cooling Water Service of TD/MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs. Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg (aaprox.) each and Approx..Quantity of instruments per set is Temperature Gauges: 12 Nos. DP Gauges - 4	Set	3
E.6.3	LGB (LGB-3) Assembly for Lub oil service of TD / MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs.Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg(approx.) each.Quantity of instruments per set is Approx.Temperature Gauges: 8 Nos. Pressure Gauge - 4 Nos.	Set	3

Item No.	Description	UOM	Qty
E.6.4	LGB Assembly for 3 Nos. CEP instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs.Approx. Quantity of instruments per set is Pressure Gauges: 6 Nos..Diff. pressure Gauges: 3 Nos.temp. gauge qty 3 nos Approximate Size 1100 x 900 x 2200 mm; Approx. Weight = 600 kg each	Set	1
E.6.5	Local instrument rack (LIR) assembly for TDBFP/MDBFP Transmitters. This LIR includes PT & DPTs,tubing , fittings, JBs, Main-fold valves and wiring from JBs to transmitters. Approximate Size 2000 x 650 x 2150 mm; Approx. Weight = 350 kg. Approx. Quantity of instruments per set is DP transmitters: 05 Nos.Pressure transmitter : 05 Nos.	Set	9
E.6.6	Local Instrument Rack (LIR) assembly for CEP-A,B&C pumps to mount Pr. Transmitters. This LIR includes Transmitters, tubing, fittings, JBs, Manifolds Valves Approximate Size: 2000 x 600 x 2150 mm;and wiring from JBs to transmitters Approx. Weight = 300 kg. Approx. Quantity of instruments per set is Pressure transmitters: 3 Nos, DP transmitters : qty 3 nos	Set	4
E.6.7	24 Terminals JB for Thrust Bearing RTDs	Nos	6
E.7.0	**SUPPORT MATERIALS**		
E.7.1	Fabrication of Local Instrument Racks, each of size 1500x1700mm with the following materials Channel (100x50mm), Angle (50x50x6mm), 4mm Thick Sheet (400x120mm) and 10mm Thick Plate (375x770mm).	MT	10
E.7.2	CS Pipe 21.3x3.73 (1/2 inch)	Mtrs	800
E.7.3	CS Pipe 60.3 x 3.91 (2 inch)	Mtrs	130
E.7.4	Cr. Al. Pipe 21.3 x 3.73 (1/2 inch)	Mtrs	500
E.7.5	SS tube 12.7x2.1	Mtrs	2000
E.7.6	SS tube 6x1.5	Mtrs	70
E.7.7	Impluse Pipes for pre instruments CS 16X2.6 (Pumps)	Mtrs	1360
E.8.0	**Cables/Cable Trays for BFP/CEPs**		
E.8.1	4 Pair x 0.5 sqmm cable	Mtrs	500
E.8.2	Perforated Cable Tray 50 mm Wide	Mtrs	80
E.8.3	Perforated Cable Tray 150 mm Wide	Mtrs	45
E.9.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		
E.9.1	Mills Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Approx. Equipment/Instruments per Set: Guided Wave Level Transmitter-03 Nos., Temperature Elements-11Nos (including gearbox), Temp.Gauges-03 Nos., DP Transmitters- 01 No., DP gauge -01 No., Pressure Gauge-3 Nos., Pressure Transmitters-03 Nos. and DP transmitter for flow measurement-02 Nos, Commissioning of LT drives-2nos.	Set	7

Item No.	Description	UOM	Qty
E.9.2	Turbine Lub Oil Purification Skid: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Switch-02 Nos., Temperature Elements-02 Nos., Temp.Gauges-03 Nos., DPI with Switch- 01 No., Pressure Gauge-04 Nos, Commissioning of LT drives-2nos.	Set	2
E.9.3	Control Valves with Smart Positioner, AFR, Limit Switches, inbuilt Postion Transmitters, Junction Box,etc	Set	8
E.9.4	Hydraulic Coupling of MDBFP: The scope of work convers A) Removal, calibration & refixing of following instruments. approx. Pressure Indicators: 6 Nos., Level Indicator-1No., DP Indicator: 1 No., Temperature Indicators: 5 Nos. Pressure Transmitters: 6 Nos. Level transmitter: 1 No. DP transmitter: 1 No. RTDs (Checking only): 24 Nos. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. C) Commissioning of Speed Indicators with transducers-3nos., Solenoid Valves-2Nos. etc.	Set	1
E.9.5	Governing Console Board: The scope includes removal, calibration and refixing of Instruments, wiring etc. Size of panel 1200 x 1850 x 450 mm The approximate quantity of instruments is Pressure Gauges: 10/6 Nos. Pressure Switches: 1 Nos. DP Switch-1 DP Gauge-1 No.	Set	2
E.9.6	Solenoid Valves	Nos	7
E.9.7	Commissioning of Mill fire fighting and Purge Air Valves (Pneumatic Operated)	Set	14
E.9.8	Commissioning of Pneumatic Actuators of Mill Discharge Valves (MDV)	Set	28
F	**VOID**		
G	**BHEL-HARIDWAR SCOPE**		
G.1.0	**GENERATOR AUXILIARY CONTROL CABINETS- INSTALLATION AND COMMISSIONING**		
G.1.1	Moisture Measurement System cabinet for Generator, including indicator cum controller placed in control room approx. 144 x 72 and sampling system in field 800mmx300mmx1000mm. Weight : 100 Kg	Set	1
G.1.2	Gen end vibration monitoring cabinet (CXW01E) dimension 800mm(W) x 800mm (D) x 2200mm (H) including special cables interconnecting PC based monitor and printer computer table etc.aprox weight 150kg	Set	1
G.1.3	Grounding Brush Monitor Approx. size & weight :235mmx285mmx110mm; 100 Kg.	Set	1
G.1.4	H2 Gas Analyzer Cabinet 800x800x2200 (mm). Weight : 400 kg	Set	2
G.1.5	Generator Instrumentation Cabinet (CXW01B). Approx. Size and weight 800mmX800mmX2200mm; Weight:450kg	Set	1
G.2.0	**INSTALLATION AND COMMISSIONING OF GENERATOR INSTRUMENTS:**		
G.2.1	Pressure Gauges	Nos	4
G.2.2	Conductivity Sensor	Nos	1

Item No.	Description	UOM	Qty
G.3.0	**REMOVAL, CALIBRATION & REFIXING OF GENERATOR AND TURBINE INSTRUMENTS**		
G.3.1	Checking the healthiness of the RTDs/Thermocouples of Generator and Turbine -Approx. 150 nos.)	Set	1
G.4.0	**LAYING AND TERMINATION OF POWER CABLES FOR 24 V SOLENOIDS**		
G.4.1	4Cx2.5 Sqmm (Normal/FS)	Mtrs	12000
G.5.0	**LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON GENERATOR PIPINGS**		
G.5.1	Pressure Gauges	Nos	11
G.5.2	Pressure Transmitters/Conductivity Transmitters	Nos	4
G.5.3	PT RTD	Nos	7
G.5.4	Dial Thermometer	Nos	5
G.5.5	Flowmeters	Nos	9
G.6.0	**LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON H2 COOLER PIPINGS**		
G.6.1	Pressure Gauges	Nos	8
G.6.2	Pressure Transmitter	Nos	1
G.6.3	RTD	Nos	7
G.6.4	Dial Thermometer/Temperature Gauge	Nos	6
G.7.0	**TURBINE INSTRUMENTATION GAUGES AND SENSORS**		
G.7.1	Thermocouples (for MAV,LBA,LBB,LBG,PGB,MAW,MAA,MAB,MAN etc)	Nos	93
G.7.2	Temperature Gauges	Nos	20
G.7.3	Pressure Transmitters / Absolute Pressure Transmitters/Differential Pressure Transmitter	Nos	53
G.7.4	Pressure Gauges	Nos	6
G.7.5	Speed Probe	Nos	7
G.7.6	Pressuer Switch	Nos	1
G.7.7	Thermocouples for HPC (Inner), HPC (Exhaust)	Nos	2
G.7.8	Level Alaram	Nos	1
G.8.0	**PRESSURE INSTRUMENTS RACKS**		
G.8.1	Instrument rack TYPE A 2200mm(W) x 650mm(D) x 2200mm(H); Weight Approx 200kg	Set	7
G.8.2	Instrument rack TYPE B 1400mm(W) x 650mm(D) x 2200mm(H) Weight Approx 150-180 kg	Set	3
G.9.0	**IMPULSE PIPES - TURBINE**		
G.9.1	SEAMLESS C.S.TUBE 21.3X2.3 ST-BQ-A1-CDS- TUBE (1/2 INCH)	Mtrs	200
G.9.2	CARBON STEEL TUBE 88.9x4 ST-B-HFSPIPES (RACK OF COND.INST.) (3 INCH)	Mtrs	40
G.9.3	SEAMLESS C.S. TUBE 21.3X2.3 ST-BQ-A1-CDS- TUBE (1/2 INCH)	Mtrs	150
G.9.4	SEAMLESS C.S.TUBE 21.3x2.3 ST-BQ-A1-CDS-TUBE (1/2 INCH)	Mtrs	120
G.9.5	SEAMLESS A.S. TUBE D=13.5X2.6 ST-2.25 CR-1MO- TUBE	Mtrs	60
G.9.6	S.L TUBES (GR.T22)21.3X2.77 ST-2.25 CR-1MO-TUBE (1/2")	Mtrs	60

Item No.	Description	UOM	Qty
G.9.7	SEAMLESS TUBE GR:T91 (13.5X2.6) HTS -ALY- ST-TUBE	Mtrs	10
G.9.8	SEAMLESS C.S. TUBE 13.5X2.6 ST-ST 35-CDS-TUBE	Mtrs	3
G.9.9	SEAMLESS TUBE GR T91 21.3X7.47 HTS-ALY-ST-TUBE	Mtrs	350
G.9.10	SEAMLESS A.S. TUBE 21.3X2.77 HTS-ALY-ST-TUBE	Mtrs	200
G.10.0	**JUNCTION BOXES-TO BE INSTALLED AND COMMISSIONED**		
G.10.1	Junction Box (to be mounted as per BHEL-Hardwar drg) and JBs for Thermocouple Transmitters	Nos	10
G.10.2	Fire protection switches & Emergency Push Buttons in Turbine Building, CCR, etc.	Nos	12
G.10.3	STRUCTURAL STEEL (for both turbine and generator instruments) 50x50x6 angle	MT	1
G.11.0	**INSTRUMENTS FOR HEAT EXCHANGERS (CONDENSER, GSC, LP HEATER-1, TOC, CFC)-TO BE ERECTED AND COMMISSIONED)**		
G.11.1	Temperature Gauges	Nos	8
G.11.2	Thermowell (125/175/325)	Nos	11
G.11.3	Level Gauge	Nos	5
G.11.4	Pressure Gauge	Nos	1
G.12.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		
G.12.1	Condenser Vacuum Pump: Removal, calibration and commissioning of CVP skid mounted instruments. The approximate quantity of skid mounted instruments shall be Pressure Transmitters - 02 Nos., Pressure Gauge-02Nos.Level Gauge and Switch-1No., Rotameter-1No., Temeprature Transmitter-2Nos., Temperature Elements-2 Nos.Temperature Gauge-4Nos; Differential Pressure Switch-1no., Differntial Pressure Gauge-1no., Commissioning of approx. Pneumatic Valve-1no., Solenoid Valve-1no., Commissining of PLC and interconnected skid mounted	Set	2
G.12.2	Oil Centrifuge Unit - Removal, calibration and refixing of all instruments mounted on centrifugal unit, checking and commissioning of the system including control panels.	Set	1
G.12.3	Position Transmitters (Removal, calibration and re-fixing)	Nos	24
G.12.4	Limit Switch (checking only)	Nos	11
G.12.5	Solenoid Valves (checking only) (steam turbine ext.valves & condenser)	Nos	62
G.12.6	Motorized temperature control valve with accessories for cold gas	Nos	1
G.12.7	Motorized temperature control valve with accessories for primary water	Nos	1

Item No.	Description	UOM	Qty
G.12.8	**HPSU Skid for Governing Control: Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, junction boxes including wiring on the rack etc. The approximate quantity of instruments is as below Pressure Transmitters-3 Nos., Pressure Switches- 3 Nos. Temperature Gauge-2 Nos, Level Gauge-2Nos., Pressure Gauge-8Nos., Temperature Regulators-3 Nos., ; Temperature Element-1Nos., Flow Switch-1No., Proximity Switch-1No., etc.**	Set	1
G.12.9	Oil Module consisting of checking solenoid valves, temperature control valve, drives, junction boxes including wiring on the rack etc. and Removal, calibration and refixing of all instruments mounted on centrifugal unit. Approx. no. of instruments are Level Transmitter-3nos., Temperature Transmitter-1 No., Temperature Gauge/Temperature Indicator-10 Nos., Pressure Indicator/Pressure Gauge-7Nos., Level Indicator-1 No., Temeprature Indicator-8 Nos., RTS-2Nos., Differntial Pressure Transmitter/Pressure Transmitter-12 Nos., Pressure Switches-3Nos.	Set	1
G.12.10	**HPU Skid for LP Bypass Control: Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, Junction Boxes, including wiring on the rack etc. The approx. quantity of instrument is as below: Temperature Transmitters-2Nos., Level Transmitter-1No., Pressure Transmitters-3Nos., Pressure Gauges-11 Nos., Pressure Switches-3Nos., Air Filter-1No., Level Gauges-2Nos., Temperature Gauges-2Nos, Differential Pressure Switch-1No. ,etc.**	Set	1
G.12.11	Seal Oil System comprising of Seal Oil Unit that consists of differential pressure regulating valves & flow regulators including checking solenoid valves, drives, junction boxes including wiring on the rack etc. Approx. quantity of instruments as follows: Pressure Gauge 10 Nos., Pressure/Differntial Pressure Switch- 02 No., Flowmeters-04 Nos., Temperature Elements- 6 Nos., Level Switch-5 nos., Level Gauges-2nos., Temperature Gauge-2 nos., Pressure Transmitter- 13 nos., Level Gauge-02nos., etc	Set	1
G.12.12	Stator Water System consisting of Pump & Filter Unit that consist of associated instruments and valves,checking solenoid valves, drives, junction boxes including wiring on the rack etc. , including wiring on the rack etc. and consists of approx. instruments like Conductivity meter-2 Nos., Flow meters- 14 Nos, Pressure gauges- 05 Nos, Pressure Transmitters-04 Nos, DP Transmitters- 01 Nos.,Temperature Elements-05 Nos., Temperature Indicators-03 Nos, Differential Pressure Switch-3Nos; Ph Transmitters-1 Nos., Level Switch-1No. , Level Transmitter-1 No., Level gauge-1No., etc.	Set	1
G.12.13	H2 Dryer Unit	Set	2
G.12.14	MOV Actuators	Nos	20

Item No.	Description	UOM	Qty
G.12.15	Liquid Detector Rack (1615mmX1740mmX400mm Wt. Approx. 95kg) Approx. number of instruments: Level Switches: 6 Nos, other interconnections with valves, wtc.	Set	1
G.12.16	NRV Valves, Stop Valves, Control Valves, LP Bypass Valves with accessories	Set	40
G.13.0	**Siemens Core part of Turbine Package**		
G.13.1	I&C Cabinet Size 1200mmX800mmX2300mm and approx. weight 300kg (CJJ11,CJJ12, CJJ13)	Nos	3
G.13.2	Lan Cabinet Approx. Size: 900mmX1000MMX2300mm and approx. weight 300kg (CRY01)	Nos	1
G.13.3	Workstations (EWS/OWS/Programmer PC)	Nos	1
G.13.4	Printer	Nos	2
G.14.0	**Turbine Control Valve Actuators (pneumatic)**	Set	9
G.15.0	**Turbine Control Valve Actuators (electric)**	Nos	2
H	**BHEL-BHOPAL SCOPE**		
H.1.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		
H.1.1	PT 100 Simplex/Duplex - 3 Wire/4 Wire RTD Sensors for winding/bearings of MDBFP/Drip Pump/CEP/CWP/Mill/DMCW/ACW,etc Motors (Removed, Calibrated & Re-fixing)	Nos	459
H.1.2	Motor Temperature Indicators (Removal, Calibrated & Re-fixing)	Nos	75
H.1.3	Electric Actuators for various sizes of Valves	Nos	20
J.	**PEM SCOPE**		
J.1.0	**Instruments**		
J.1.1	Ultrasonic Flow Transmitter with Controller	Nos	3
J.2.0	**Laying and Termination F-Type (Individual Pair and overall Screened), Twisted Pair Armoured Instrumentation Cables**		
J.2.1	2 Pair x 0.5 sqmm	Mtrs	70800
J.2.2	4 Pair x 0.5 sqmm	Mtrs	46400
J.2.3	8 Pair x 0.5 sqmm	Mtrs	21600
J.2.4	12 Pair x 0.5 sqmm	Mtrs	14800
J.2.5	24 Pair x 0.5 sqmm	Mtrs	2800
J.3.0	**Laying and Termination of G-Type (Overall Screened), Twisted Pair Armoured Instrumentation Cables**		
J.3.1	2 Pair x 0.5 sqmm	Mtrs	2000
J.3.2	4 Pair x 0.5 sqmm	Mtrs	42000
J.3.3	8 Pair x 0.5 sqmm	Mtrs	83600
J.3.4	12 Pair x 0.5 sqmm	Mtrs	44400
J.4.0	**Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)**		

Item No.	Description	UOM	Qty
J.4.1	Control Valves with Smart Positioner, AFR, Air Lock Valve etc., LO TCV, Gland Steam inlet and dump	Set	24
J.4.2	Electric Actuators for Butterfly Valves/Gate Valve	Nos	4
J.4.3	Oxygen Dosing Skid for CPU Discharge /Dearator O/L - Approximate qty of instruments per skid is Pressure Gauges: 03 Nos., Mass flow controllers- 01 Nos., Pressure Safety Valve - 2 nos. Pressure Transmitter: 3 Nos., Solenoid Valves : 3 No. Junction boxes: 1 Nos, oxygen cylinders - 2 Nos	Set	2
J.4.4	Ammonia Dosing Skid - Approximate qty of instruments per skid is Pressure Gauges: 03 Nos., Level Gauge- 02 Nos, Pressure Transmitter: 01 Nos, level Transmitter: 02 Nos Differential Pressure Transmitter-01 No., Differential Pressure Gauge-1 No.; &Motorized Valve - 01 No.	Set	1
J.4.5	NaOH Dosing Skid - Approximate qty of instruments per skid is Pressure Gauges: 01 No., Level Gauge- 01 No., Pressure Transmitter: 01 No., Level Transmitter: 02 No. Differential Pressure indicating Transmitter - 01 No., Differential Pressure Gauge-1No. &Motorised Valve 1 No., etc.	Set	1
J.4.6	Hydrazine dosing Skid- Approximate qty of instruments per skid is Pressure Gauges: 02 Nos., Level Gauge- 03 Nos, Pressure Transmitter: 02 Nos, level Transmitter: 06 Nos Differential Pressure Transmitter-01 No., Differential Pressure Gauge-1 No.; &Motorized Valve - 02 No., etc.	Set	1
J.5.0	**Citric Acid Cleaning for Boiler - Installation and Removal**		
J.5.1	Temp. Gauges	Nos	3
J.5.2	Pressure Gauges	Nos	2
J.5.3	Thermocouple Stem type and MTM	Nos	8
J.5.4	Junction Boxes	Nos	3
K.	**PESD SCOPE**		
K.1.0	**VOID**		
K.2.0	**VOID**		
K.3.0	**Instruments of Medium Velocity Water Spray System (MVWSS)**		
K.3.1	Solenoid Valves	Nos	46
K.3.2	Erection and Commissioning of Local Deluge Valve Control Panels of App. Dimension (Lx W X D - 450mm x 450mmx 150mm) & (10 Kgs)	Nos	46
K.4.0	**C&I of High Velocity Water Spray System (HVWSS)**		
K.4.1	Pressure Switches	Nos	32
K.4.2	Solenoid Valves	Nos	16
K.4.3	Erection and Commissioning of Deluge Valve Control Panels of (Lx W X D - 450mm x 450mmx 150mm) & (10 Kgs)	Nos	16
K.5.0	**VOID**		
K.6.0	**Fire Detection & Alarm System (FDA)-Erection and Commissioning**		
K.6.1	Fire Alarm Panels (with Optical Fibre Card and Batteries) of App. Size: 1000(H)x600(W)x300(D) in mm and App. Wt 100 kg each.	Set	2

Item No.	Description	UOM	Qty
K.6.2	VOID		
K.6.3	Multisensor Detectors	Nos	735
K.6.4	Heat Detectors	Nos	36
K.6.5	Air Sampling Detector	Nos	5
K.6.6	Flame Detectors	Nos	5
K.6.7	Infra Red Detectors with Air Purge Unit	Nos	31
K.6.8	Manual Call Points (Indoor)	Nos	98
K.6.9	Manual Call Points(Outdoor)	Nos	49
K.6.10	Optical LHS Cables for Cable Galleries	Mtrs	11229
K.6.11	Optical LHS Cables for Coal Conveyors	Mtrs	5884
K.6.12	Optical LHS Controllers (150mm (H) x 450mm (W) x 350mm (D))	Nos.	1
K.6.13	IO Modules of size (Approx. 50 mm x 22 mm (Ø x H)) & Weight - 35gm each.	Nos	175
K.6.14	Hooter cum Strobe	Nos	99
K.6.15	Power Supply Modules (230 V to 24 V DC Converters) of size 400 (W) x 250 (D) x 120 (H) and app. Wt. 8 kg each.	Nos	10
K.6.16	Response Indicators	Nos	137
K.6.17	Exit Sign (Back-lit)	Nos	121
K.6.18	Laying and Termination of Loop Cables (Fire Survival type) 2Cx1.5 Sqmm	Mtrs	43400
K.6.19	Laying and Termination of Power Cables (Fire Survival type) 2Cx2.5 Sqmm	Mtrs	26950
K.6.20	Laying and Termination of Loop Cables (MICC type) 2Cx1.5 Sqmm	Mtrs	1225
K.6.21	Laying and Termination of Power Cables (MICC type) 2Cx2.5 Sqmm	Mtrs	525
K.6.22	HDPE Conduit for Optical Fibre Cable	Mtrs	2450
K.6.23	Laying of Optical Fibre Cable	Mtrs	2450
K.6.24	Splicing of OFC	Nos	16
K.6.25	Pressure Switch	Nos	192
K.6.26	MS Angle, Size: 50x50x6	MT	1
K.6.27	Deluge Valve Local Control Panel Approx. size :: in mm 450 x 450 x 150 (H x W X D)	Nos	8
K.7.0	**Inert Gas Extinguishing System (IGES)-Erection and Commissioning**		
K.7.1	Discharge Indicator (131 (L) x 127 (W) x 38 (D) mm, 200 gms each) along with JB	Nos	3
K.7.2	Pre-Discharge Indicator (131 (L) x 127 (W) x 38 (D) mm, 200 gms each) along with JB	Nos	3
K.7.3	Manual Release Push Button approx. dimension 121 (L) x 82 (W) x 23 (D), 420 gms	Nos	3
K.7.4	Laying and termination of Control Cables of 2C x 1.5 Sqmm armoured Control Cable	Mtrs	525
K.7.5	300mm Cable Tray and accessories	Mtrs	35

Item No.	Description	UOM	Qty
K.7.6	Abort Switch	Nos	3
L	Electronic Earth Pits: Treated Earth pit of Galvanised MS pipe of 65 mm Dia, 3000 mm long with clamp, funnel and accessories including all civil works, filling of earth pit of size min 400x400x3000 mm with alternate layer of charcoal & salt as per IE specification and making of brick chamber, with both side plastering, supply and fixing of manhole with CI cover plate/RCC Slab etc. complete as per IS 3043 (only 3000 mm long, 65 NB Galvanized MS pipe shall be supplied by BHEL; All other accessories as mentioned above are in vendor's scope). If desired resistivity is not achieved then Bentonite mix to be used by the contractor. Supply of Bentonite mix is in the scope of bidder, without extra cost.	Nos	10

1.9.2. **NOTE:**

1. The BOQ Ref. no given above may be linked with the BOQ Ref no in Price bid.
2. The Price bid contains the consolidated list of BOQ with brief description of items.
3. Before quoting in the Price bid, the bidder shall go through the detailed specification of all items of BOQ as well as Scope of Work as specified in relevant Clause of this document.
4. The quantity indicated in the BOQ / Price bid is approximate only and is liable for variation. Payment will be as per actual quantity erected / commissioned as certified by BHEL Engineer.

VOLUME-IA PART –I CHAPTER –X
GENERAL

The scope of the work will comprise of but not limited to the following:
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.10.1 Successful Bidder is requested to furnish the following at PSSR-HQ Chennai immediately after release of Letter of Intent (LOI)

i) Security Deposit

ii) Unqualified Acceptance for LOI, Detailed LOI / Work Order.

iii) Rs.160/- Stamp Paper for preparation of Contract Agreement.

1.10.2 Successful Bidder is requested to furnish the proof of documents for the following at the respective PSSR- Site

i) PF Regn No.

ii) Labour License No.

iii) Workmen Insurance Policy No.

1.10.3 In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following.

1.10.4 PROVIDENT FUND

1.10.4.1 The contractor is required to extend the benefit of Provident Fund to the labour employed by you in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, you are hereby required to get yourself registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to you by the Provident Fund authorities within *one* month from the date of issue of the letter of intent. In case you are exempted from such remittance an attested copy of authority for such exemption is to be furnished. Please note that in the event of your failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to us by the customer or paid to statutory authorities by us, such amount will be recovered from payments due to you.

1.10.4.2 The final bill amount would be released only on production of clearance certificate from PF / ESI and labour authorities as applicable.

1.10.5 OTHER STATUTORY REQUIREMENTS

1.10.5.1 The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and

Valid WC Insurance copy or ESI Code (if applicable) and PF code no. along with the first running bill.

1.10.5.2 The contactor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r78(1)(a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with Challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.

1.10.5.3 The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

1.10.5.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen under I D Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act 1948 (if applicable) to BHEL along with the Final Bill.

1.10.5.5 In case of any dispute pending before the appropriate authority under ID Act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

1.10.5.6 In case of any dispute prolonged / pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.

1.10.6 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.

The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training. Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of

qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 160 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

1.10.7 Site Visit by the Bidder

1.10.7.1 The bidder shall, prior to submitting his tender for the work, visit, examine and acquire full knowledge & information and necessary conditions prevailing at the site and its surroundings of the plant premises together with all statutory, obligatory, mandatory requirements of various authorities about the site of works at his own expense, and obtain and ascertain for himself on his own responsibility that may be for preparing his tender and entering into a contract, and take the same into account in the quoted contract price for the work.

1.10.7.2 The bidder shall satisfy themselves about the following factors:

i). Site conditions including access to the site, existing and required roads and other means of transport/communication for use by him in connection with the work including diverting and re-routing of services.

ii). Requirement and availability of land and other facilities of his enabling works, establishment of his nursery, office, stores etc.

iii). Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there-from.

iv). Source and extent of availability of suitable materials, including water etc., and labour (skilled and unskilled) required for work, and laws and regulations governing their use and employment.

v). Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the work.

vi). The limit and extent of surface and subsurface water to be encountered during the performance of the work, and the requirement of drainage and pumping.

vii). The type of equipment and facilities needed, for and in the performance of the work;

viii). The extent of lead and lift required for the work in complete form over the entire duration of the contract, and

ix). All other information pertaining to and needed for the work including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this contract.

1.10.7.3 The bidder should note that information, if any, in regard to the local conditions, as contained in these tender documents, has been given to tenderer merely for guidance and is not warranted to be complete.

1.10.7.4 A bidder shall be deemed to have full knowledge of the site, whether he inspects it or not, and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

1.10.7.5 The bidder and any of his personnel or agents will be granted permission by the Site-In-Charge or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises and lands for purpose of such inspection, but only on the express condition that the tenderer (and his personnel and agents) will relieve and indemnify the Employer (and his personnel and agents) from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.

1.10.7.8 The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, engineering and construction management. The contractor must have adequate quantity of tools, construction aids, equipments etc., in his possession. He must also have on his rolls adequately trained, qualified and experienced supervisory staff and skilled personnel.

1.10.7.9 It is not the intent to specify herein all details of all material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

1.10.7.10 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.10.7.11 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.

1.10.7.12 The contractor shall carry out additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.

1.10.7.13 The work shall be executed under the usual conditions without affecting power plant construction / operation and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co- operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.10.7.14 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

1.10.7.15 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence. Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.

1.10.7.16 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

1.10.7.17 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor.

1.10.7.18 Contractor shall retain all T&P / Testing instrument / Material handling equipment's etc. at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.

1.10.7.19 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

1.10.7.20 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for construction, agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.10.7.21 Contractor has to work in close co-ordination with other agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and Construction program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.10.7.22 The contractor must obtain the signature and permission of the security personnel of the customer / BHEL for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside. Surplus materials including steel item brought at site by the contractors with proper documentation and Gate pass, shall be allowed to taken out of the project premises after completion of relevant works, on certification by BHEL in charge.

1.10.7.23 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect.

1.10.7.24 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.

1.10.7.25 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc. for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.

1.10.7.26 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.

1.10.7.27 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.

1.10.7.28 Sometimes, it may be required to re-schedule the activities to enable other agencies to commence/ continue the work so as to keep the overall project schedule.

1.10.7.29 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.10.7.30 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

1.10.7.31 On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.10.7.32 It is the responsibility of the contractor to do the checking, testing etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. The testing will be completed only when jointly certified so, by the BHEL Engineer.

1.10.7.33 If any item not covered but requires being executed, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible

from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

1.10.7.34 The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

1.10.7.35 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess drawls at the rate prescribed by manufacturing units.

1.10.7.36 Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer for other agencies, like Boiler, piping, Turbine, Generator erection, Cabling, instrumentation, insulation etc., to commence their work from / on the equipments coming under this scope.

1.10.7.37 For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.

1.10.8 RECORDS TO BE MAINTAINED AT SITE:

Record of Quantity of FREE/Chargeable items issued by BHEL must be maintained during contract execution. Also reconciliation statement to be prepared at regular intervals.

The under mentioned Records/ Log-books/ Registers applicable to be maintained.

(i) Hindrance Register

(ii) Site Order Book.

(iii) Test Check of measurements.

(iv) Steel & Cement Supply and Consumption Daily Register

(v) Records of Test reports of Field tests.

(vi) Records of manufacture's test certificates.

(vii) Records of disposal of scraps generated during and after the work completion.

1.10.9 VOID

1.10.1. **OTHER GENERAL REQUIREMENTS**

1.10.1.1. The scope of specification covers the installation, testing and commissioning of the erected equipment / instrument along with accessories as detailed in Bill of Quantity.

1.10.1.2. Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erecting the equipment, aligning, fastening, supporting, cleaning, checking and carrying out statutory tests as required, trial operation, pre-commissioning, commissioning and post-commissioning activities up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion contract period (including extended period) whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.

1.10.1.3. Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc., in their possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.10.1.4. It is not the intent to specify herein all details of material. Any item related to this work not covered here but necessary to complete the system will be deemed to have been included in the scope of the work.

1.10.1.5. The contractor shall have valid ELECTRICAL LICENCE as required to carry out the scope of work indicated in the BOQ.

1.10.1.6. All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

1.10.1.7. Contractor shall erect all items/materials etc. as per sequence prescribed by BHEL at site. BHEL engineer depending upon the availability of materials/work fronts etc. will decide the sequence of erection/commissioning methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of erection/commissioning adopted in erection/commissioning of similar job or for any reasons whatsoever.

1.10.1.8. Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with

drawings, specifications and manufacturer's recommendations and Field quality plans of BHEL.

1.10.1.9. The contractor shall co-ordinate and provide assistance for satisfactory testing, pre-commissioning, commissioning and trial run of the connected equipment under overall guidance of BHEL and shall locate any cause of malfunction and rectify the same for proper operation. Testing shall also include any additional tests, which the Engineer feels necessary because of site conditions and also to meet system specification.

1.10.1.10. During the course of erection, testing and commissioning certain rework / modification/ rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and/ or units under erection and commissioning and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously. Payments for such works shall be governed by Cl. No. 2.15.1 of GCC.

1.10.1.11. The work shall be executed under the usual conditions without affecting power plant construction and in conjunction with other operations and contracting agencies at site. The contractor and their personnel shall co-operate with the personnel of other agencies, co-ordinate their work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.10.1.12. If any item or equipment not covered but requires being erected/commissioned, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

1.10.1.13. After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.

1.10.1.14. Contractor shall, transport all materials to site and unload at site / working area, or pre-assembly yard for inspection and checking. All material handling equipment required shall be arranged by the contractor.

1.10.1.15. Contractor shall retain all T&P / Testing instrument / Material handling equipment etc., at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.

1.10.1.16. Contractor shall remove all scrap materials periodically generated from their working area in and around power station and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents. If the contractor fails

to remove the scrap material, BHEL reserves the right to collect and remove the scrap and recover the cost incurred for the same along with BHEL overheads from the contractor. All the package materials, including special transporting frames, etc., shall be returned to the BHEL stores / customer's stores by the contractor.

1.10.1.17. The scrap generated after executing the work shall be returned to BHEL earmarked area every week and the same shall be vetted by the Engineer-in- charge, to be produced along with the running bill.

1.10.1.18. The contractor at their cost shall arrange necessary security measures for adequate protection of their machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of their machinery equipment tools etc.,

1.10.1.19. The contractor shall ensure that their premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer- in-Charge.

1.10.1.20. The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for erection agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.10.1.21. All the surplus, damaged, unused materials, package materials, containers, special transporting frames, gunny bags etc. shall be returned to the BHEL stores / customer's stores by the contractor.

1.10.1.22. If required by BHEL, the contractor shall change the sequence of their operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

1.10.1.23. Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.

1.10.1.24. Contractor has to work in close co-ordination with other erection agencies at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less/more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange &augment the resources accordingly.

1.10.1.25. The contractor must ensure the necessary formalities like availability of gate pass, etc. for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside.

1.10.1.26. The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe/tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange themselves all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.

1.10.1.27. The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess drawals at the rate prescribed by manufacturing units.

1.10.1.28. No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.

1.10.1.29. Contractors shall ensure that all their Staff/Employees are exposed to periodical training program conducted by qualified agencies/ personnel on ISO 9001/2015 Standards.

1.10.1.30. For other agencies, such as piping, Boiler, ESP, TG, insulation etc., to commence their work from/on the equipment's coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence/continue the work so as to keep the overall project schedule.

1.10.1.31. The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.10.1.32. For the purpose of planning, contractor shall furnish to BHEL Site Engineer the estimated requirement of power (month wise) for execution of work in terms of maximum kW demand, before starting the work at site.

1.10.1.33. On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at their cost. In the event of their failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.10.1.34. Prior to erection of any components, inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.

1.10.1.35. All the equipment /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.

1.10.1.36. It is the responsibility of the contractor to do the alignment, checking, etc., if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment

will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.

1.10.1.37. No temporary supports shall be welded on the pressure parts of piping. Welding of temporary supports, cleats, etc. on the boiler columns shall be avoided. In case of absolute necessity contractor shall take prior approval from BHEL Engineer. Further, any cutting or alternation of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer.

1.10.1.38. In electrical MCC's the fixed and moving contacts in contactors & Copper strips shall be removed and kept in safe custody. The same shall be re-erected during commissioning of the system.

1.10.1.39. Whenever cable glands are supplied along with MCC'/JB's/ PB's/etc. they shall be removed and kept in safe custody. The same shall be re-erected during cable termination.

1.10.1.40. Permanent nomenclature/identification on LPBS/Junction boxes/Local Motor Starter boxes/AC Fuse DB/DC Fuse DB/Heater JB/Control panel, LT panel & individual feeders, SP Bus duct, heater JB, Transformers are to be done by the contractor as per the requirement decided BHEL Engineer at site.

1.10.1.41. All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there (if required) and there is no extra cost in this regard.

1.10.2. **Any modification work required by inspector shall be attended by the contractor. Modifications which had raised due to execution deficiencies are at the cost of contractor whereas modifications which are due to design change shall be treated as extra work.**

1.10.3. **SITE INSPECTION**

1.10.3.1. Various Inspection / quality control / quality assurance procedures/methods at various stages of erection and commissioning will be as per BHEL / Customer quality control procedure / codes and other statutory provisions and as per BHEL Engineer's instructions.

1.10.3.2. The owner / employer or their authorized agents may inspect various stages of work during the currency of the contract awarded to them. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

1.10.3.3. BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL.

1.10.3.4. Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour and get the work executed through other agency and debit the cost including overheads to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.10.4. **MANPOWER REQUIREMENT**

1.10.4.1. Manpower requirement for Erection and Commissioning shall be as follows:

a) There shall be a Resident manager as Site In Charge at site, under whom there shall be sufficient area engineers who shall take care of the erection activities.

b) Resident Engineer should have a minimum qualification of Electrical/Electronics/C&I Engineering Degree with minimum 5 years' experience or Diploma in Electrical/Electronics/C&I Engineering with minimum 10 years of experience in Thermal Power Station.

c) Area Engineer should have minimum qualification of Diploma in Engineering or any graduate with minimum 3 years of experience in Thermal Power Station.

d) Supervisor should have a minimum qualification of Diploma in Electrical/Electronics/C&I engineering or any graduate with minimum 3 years of experience in Thermal Power Station.

e) Lab Technicians should have 2 years' experience in Thermal Power Stations.

f) Contractor should have one Store Keeper, one Transport Supervisor for the safe transportation of materials.

g) Planning / safety Engineers should be available and they should have experience in construction field especially in power plant.

h) Dedicated commissioning engineer should be deployed for commissioning of the equipment.

i) Licensed supervisor-01 No. with valid HT/LT electrical license

1.10.4.2. There shall be three separate Erection In-charges, each for Boiler, TG, Station C&I. They shall work independently with required manpower, T&P etc., including storage facilities. Each Erection In-charge shall have minimum two erection engineers with adequate Supervisors and Technicians.

1.10.4.3. There shall be separate engineers for Planning, Safety and Quality.

1.10.4.4. Planning/Safety Engineers should have experience in construction field especially in power plant.

1.10.4.5. Each area engineer shall be provided with minimum four (04) supervisors and adequate number of Technicians / electricians and other erection staff and T&P etc.

The testing Engineers / supervisors / electricians shall be identified separately for each unit and the minimum requirement shall be as indicated in previous Clause. Besides, there shall be separate engineers for Planning, Safety and Quality.

1.10.4.6. The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor.

1.10.4.7. The testing Engineers/supervisors/electricians shall be identified separately for each unit as per the site requirement.

1.10.4.8. The Site in charge shall be provided with PCs and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities will not be an excuse for extension of completion date.

1.10.4.9. All instructions from BHEL / Customer will be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name their authorized representative prior to or immediately on commencement of operations at site.

1.10.4.10. The Site In charge shall be present at site during all normal working hours and their contact address after normal working hours shall be made available to BHEL so that if any emergency arises, the presence of the contractor's site Representative at site can be called for.

1.10.4.11. The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed to suffer delay on this account.

1.10.4.12. The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of their duties the contractor shall remove them from site as directed by Site Engineer.

1.10.4.13. The contractor shall ensure that all their supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the contractor's personnel shall be brought to the attention of the contractor's site representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required by the Engineer-in-Charge.

1.10.4.14. The contractor shall ensure that replacement for such persons removed from site is provided immediately and the work is not allowed to suffer delay on that account.

1.10.5. **DOCUMENTATION**

1.10.5.1. The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval.

a) Bar chart covering planned activities at site

b) Detailed organization chart

c) Details of T&P available with contractors with documents proofs.

1.10.5.2. The following information shall be furnished by the bidder after testing and inspection:

a) Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by customer's representative also, wherever called for as per field quality plan.

b) **As built drawings:** After successful completion, testing and commissioning of installation work, Purchaser's drawings / documents shall be updated in line with the actual work carried out and as built drawings / documents shall be submitted by the contractor as agreed for the project.

VOLUME-IA PART –I CHAPTER –XI
FOUNDATIONS AND GROUTING

The scope of the work will comprise of but not limited to the following.

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified)

1.11.1. **FOUNDATIONS, GROUTING AND CIVIL WORKS**

1.11.1.1. Foundation for the equipment to be erected shall be provided by BHEL/ clients of BHEL. The dimension of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. Minor adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipment plants shall be carried out by the contractor.

1.11.1.2. Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., de-watering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form/shuttering work are within the scope this work.

1.11.1.3. The contractor at their cost shall arrange for grouting of foundation bolt holes of equipment as specified in the drawings / specification or as advised by the Engineer of BHEL after preparing the foundation top surface for grouting, all the materials for grouting (sand, gravel & cement including special Cement) shall be arranged by the contractor. The grouting has to be done up to basement level. The required consumables like Portland cement, gravel, sand etc., have to be provided by the contractor at their cost. If required special cement like conbextra, GP1, GP2, PAGAL, shrinkomp etc., or its equivalent as approved by BHEL shall be arranged by the contractor at their cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.

1.11.1.4. It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 30 mm for obtaining proper face for packer plates/shims, which may be required for the erection of the equipment/plants will have to be carried out by the contractor without extra cost.

1.11.1.5. The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipment.

1.11.1.6. Foundation pockets are to be cleaned thoroughly before placing the equipment. Verticality of foundation bolts to be checked along with correctness of the threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.

1.11.1.7. The concrete foundation, surfaces shall be properly prepared by chipping, as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment. Packer plates should not only be blue matched with foundation but also inter-packer contact surfaces between the packers and foundation frame etc., shall also be blue matched by Prussian Blue match checks and required percentage contact shall be achieved by chipping and scrapping as per BHEL Engineers instructions.

1.11.1.8. The certificates of the grout are to be submitted to BHEL. If necessary, test cubes are to be made and tested at site to ensure the quality of the grout as per relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc to be arranged by the contractor including the fine aggregates.

1.11.1.9. Certain packer plates and shims over and above the quantity received as part of supplies from manufacturing units of BHEL will have to be cut out from steel plates/sheets at site by the contractor to meet site requirement. However, machining of the packers, wherever necessary, will be arranged by BHEL at free of cost.

1.11.1.10. Shims and packer plates required for temporary use are to be arranged by the contractor within the quoted rate.

1.11.1.11. The contractor at their cost shall arrange for grouting of anchor points of T & Ps issued to them. Necessary grout materials are to be arranged by the contractor at their cost.

1.11.1.12. Works such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin etc. are covered in the scope of work.

1.11.1.13. Minor civil works like drilling, chipping and punching holes on slabs and brick- walls and grouting related to installation of LIR / LIE / Local Gauge Board, control panels, Junction boxes etc., shall be included in the erection cost of such items. No separate payment is applicable. The scope also includes supply of grouting material. More details regarding scope of civil are given in the respective equipment erection.

1.11.1.14. **PROCEDURE FOR GROUTING:** Contractor has to carry out the grouting as per the work instructions for grouting available at site.

VOLUME-IA PART –I CHAPTER -XII
MATERIAL HANDLING, TRANSPORTATION AND SITE STORAGE

The scope of the work will comprise of but not limited to the following:
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.12.1. COLLECTION OF BHEL SCOPE OF SUPPLY MATERIALS

1.12.1.1. BHEL shall issue materials covered in BHEL scope from their stores at site. The contractor shall collect such materials from BHEL stores and transport to site of work at their cost.

1.12.1.2. The contractor shall inspect such materials as soon as received by the contractor and shall bring to the attention of the Engineer-in-Charge any shortage / damage or other defects noticed before taking over the materials. Materials once taken over will be deemed to have been received in good condition and in correct quantities except for intrinsic defects which cannot be observed by visual and dimensional inspection and weighing.

1.12.1.3. Upon receipt by the contractor the responsibility for any loss, damage and / or misuse of such materials shall rest with the contractor.

1.12.1.4. All materials issued by BHEL shall be properly stored and systematic records of receipts, issue and disposal will be maintained. Periodic inventory shall be made available to BHEL Engineer-in-Charge.

1.12.1.5. All materials issued by BHEL shall be utilized as directed by Engineer-in- Charge or most economically in the absence of such direction. The contractor shall be responsible for the return to BHEL Stores of all surplus material, as determined by the Engineer-in-Charge.

1.12.1.6. If the materials issued by BHEL are lost, damaged or unaccounted, the cost of such items shall be recovered from payments to the contractor. However, the contractor shall raise FIR and inform BHEL all details.

1.12.2. STORAGE

1.12.2.1. Materials shall be stacked neatly, preserved and stored in the contractor's shed/ work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area/ site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

1.12.2.2. The equipment should be preferably in its original package and should not be unpacked until it absolutely necessary for its installation. The equipment should be best protected in its cases. It should be arranged away from walls.

1.12.2.3. The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damps, sinking into around and to circulate air under the stored equipment. This will also help in lifting the packing with fork lift truck.

1.12.2.4. Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced or regenerated when de-colorization takes place. BHEL shall supply the material and contractor shall replace.

1.12.2.5. Due care should be taken to ensure that the equipment is not exposed to fumes gases etc. which can affect electrical contacts of relays and terminal boards.

1.12.2.6. The storage room and the equipment should be checked at regular interval of three months to ensure protection from termites, mound growth, condensation of water etc. which can damage the equipment.

1.12.2.7. Contractor shall keep BHEL informed about such problem and try to rectify the problem at their cost.

1.12.2.8. All the instrument, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to site.

1.12.2.9. Packing material shall be retained if the cubicle to be repacked after inspection

1.12.2.10. The loose items supplied for the main equipment falling into various categories like tools, modules, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, PCs, monitors, cable glands, cable ducts, frames etc. are to be categorized and stored separately with proper identification.

1.12.2.11. **Sub-Assemblies:**

a) All sub-assemblies should be kept in a separate place where it is easily accessible.

b) Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should also be kept along with it.

c) Sub-assemblies should not be stacked one above the other.

1.12.2.12. **Loose items (wherever applicable):** The loose items supplied for the main equipment falling into various categories like tools, modules, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, PCs, monitors, cable glands, cable ducts, frames are to be categorized and stored separately.

1.12.2.13. Sometimes it may become necessary for the contractor to handle certain unrequired components at Customer's / BHEL's stores in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

1.12.2.14. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site.

1.12.2.15. Contractor has to arrange required fire resistant tarpaulins to protect the machined components / assembled parts drawn from BHEL, before and after erection at their cost.

1.12.2.16. The contractor shall take delivery of item, materials and consumables from the storage yard / stores / sheds of BHEL / customer which are within a radius of 5 kms, after getting approval of engineer / customer in the prescribed indent forms of BHEL / customer. He shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to them till they are fully erected, tested and commissioned.

1.12.2.17. Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipment from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators, Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.

1.12.2.18. The equipment / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

VOLUME-IA PART – I CHAPTER- XIII
SCOPE OF C&I WORKS-DETAILED

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

It is not the intent to specify herein all details of material. Any item related to this work, not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

1.13.1. **DETAILED SCOPE OF C&I WORK**

The scope of work for C&I items like Instruments, Panels, Hardware etc. covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, calibration, checking, erection, testing, loop checking & commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, ferrules, lugs (specific sizes), specific types of fasteners, paints and consumables. deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipment, testing instruments (excepting proprietary type instruments). Returning of un-used materials / items to stores are also covered in the scope of work.

1.13.2. **SCOPE OF WORK FOR C&I PANELS / CONTROL DESK:**

1.13.2.1. The different types of Microprocessor based panels like VALMET DNA DCS Panels, Instrument Panels, unit control desk etc. are covered in the scope of work for erection and commissioning.

1.13.2.2. The unit rate quoted for Installation of control panels shall include fixing of anti-vibration pads, levelling and alignment, welding, grouting, drilling of bottom gland plates for cable entry as required, closing control panels bottoms with suitable flame proof compounds wherever required and checking of internal wiring, instruments, components etc. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels except the Instruments identified in the BOQ.

1.13.2.3. Panels are normally supplied in suite of one / two / three/ four / Five cubicles with bottom base frame and these panels are to be mounted on separate site fabricated base frames as per site condition. The base frames to be properly grouted to the concrete floor or to be TIG welded to the embedded insert plates. The structural steel material for the above will be supplied by BHEL. For fabrication and erection of frame, unit rate shall be paid be as per rate schedule, on tonnage basis

1.13.2.4. For panels to be mounted on trenches, if any channel supports are required, the same shall be provided across the cable trenches over which the base frames of

the panels shall be mounted. Similarly, for the panels to be mounted on false flooring, if mounting frames are not provided, same shall be fabricated at site. The contractor shall carry out fabrication and erection of these support structures on tonnage rate basis. For fabrication and erection of frame, unit rate shall be paid be as per rate schedule, on tonnage basis.

1.13.2.5. The panels which are supplied for various control systems have to be erected at different places like unit control room/ near the equipment/ various operating floors as per site layout. The contractor shall take the panels to the desired locations either through floor openings or temporary openings. No claims will be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.

1.13.2.6. If any minor grinding is to be carried out on the cut-outs provided in the panels for mounting instruments like recorders, indicators, console etc., the same shall be carried out by the contractor at no extra cost.

1.13.2.7. All the panels and JBs shall be electrically earthed to the nearest earth grid by means of GI wire/Flats as per the instructions of BHEL engineer.

1.13.2.8. Painting of fabricated parts and earthing conductors of panels shall be part of the work. Touch up painting for panels, including supply of paints shall be carried out by the contractor within the quoted rate.

1.13.2.9. Closing the Panel openings and unused drilled holes with non-flammable sealant materials, including supply of above material, shall be part of erection work.

1.13.2.10. For panels/ equipment erected by other agencies, commissioning work and troubleshooting are to be carried out by the contractor as per the rate quoted in the schedule.

1.13.2.11. Normally the panels shall be supplied with instruments / modules mounted and wired. No separate payment shall be made for commissioning of any instrument/ cards/ components. If dismantling of the above such instruments and rewiring is needed at site, the same shall be carried out at no extra cost. If any instruments/ cards/ components supplied as loose items for safe transit, the same shall be mounted and wired at no extra cost unless specified otherwise in the BOQ. Similarly, if any loose supplied instruments /modules are to be mounted and wired on customer panels or any other panels not erected by contractor, the same shall be carried out at no extra cost unless otherwise specified in the BOQ. However, if any major installation/modification/wiring are involved, the same may be carried out as extra work. The decision of BHEL Engineer shall be final in respect of above extra works.

1.13.2.12. Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within ±20% shall not be considered for payment. However, for variations beyond ±20%, payment shall be considered proportional to the length of the panel.

Variations in depth, height or weight of the panel shall not be considered for payment.

1.13.3. **UPS, AC & DC DB AND OTHER ELECTRICAL CONTROL PANELS, VFD Panels, etc.**

The erection & commissioning scope of above panels will be in line with clauses above in 1.13.2.

1.13.4. **SCOPE OF WORK OF DCS PACKAGE / HMI / STATION LAN / / OPERATOR STIMULATOR / MASTER AND SLAVE CLOCK / PADO SYSTEM / EPBAX/ WIRELESS COMMUNICATION / OPERATING DESK AND FURNITURES etc WITH RELATED INSTRUMENTATION:**

1.13.4.1. BHEL will supply sophisticated VALMET DNA DCS system. The tentative details of are furnished in the BOQ.

1.13.4.2. The scope of DCS system includes erection of sophisticated microprocessor based systems, VALMET DNA DCS for Main plant DCS control panels, I/O panels, Ethernet switching panels, Network Enclosure cabinets, GIU, CPU, MIS System, Engineers workstations, operator workstations, large video screen, server, printers, plant security system, portable UPS power supply, furniture and interconnecting cables like Ethernet/ Fiber-optic etc.

1.13.4.3. The scope of work for DCS Panels will generally be in line with that for C&I Panels as detailed in Clause 1.13.2

1.13.4.4. Unit rate quoted for DCS equipment shall cover installation & integration of all the above said equipment and providing necessary commissioning assistance. No separate unit rate applicable for installation of loose items/ modules/ components or accessories including furniture etc, which is not explicitly mentioned in the BOQ, but comes as part of the system.

1.13.4.5. Laying and termination of all cables including Ethernet and fiber optic cables as detailed in the scope of work for cabling. Splicing/Termination of fibre optic cables is included in the scope of this contract.

1.13.4.6. If any underground C&I works for firefighting systems, the earth excavation and earth filling is excluded from the scope of the C&I contractor.

1.13.5. **SCOPE OF WORK FOR UPS, BATTERY AND BATTERY CHARGER**

1.13.5.1. The charger and batteries are of heavy duty type. The cells will be mounted on insulators carried on suitable wooden / fiber stands. Tentative details are given in the BOQ.

1.13.5.2. BHEL will provide vendor's technical support for commissioning of Battery and Battery charger. The contractor shall carry out the works as per instructions of BHEL/ Vendor Engineer.

1.13.5.3. Lump sum shall be quoted for Erection and commissioning of Battery. No additional payment shall be made for any variation in the number of cells. The unit rate quoted

for erection of battery will include the following works.

1.13.5.3.1. Filling the individual cells with Acid/alkali – if applicable.

1.13.5.3.2. Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.

1.13.5.3.3. Arranging manpower in shift during battery charging and discharging cycles that may be carried out round the clock as per the code of practice, and conducting other routine tests as per IS under the supervision of BHEL Engineer.

1.13.5.3.4. Modifications or changes if any for the loose supplied items or any minor changes in wiring.

1.13.5.3.5. Arranging necessary tools, T&P, testing equipment's required for erection and commissioning of the battery.

1.13.5.3.6. For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.

1.13.6. **SCOPE OF WORK FOR BATTERY CHARGER PANELS**

1.13.6.1. The scope of work will be in line with scope of work for control panels, as detailed under Clause above in 1.13.2.

1.13.7. **SCOPE OF WORK FOR INSTRUMENTS:**

1.13.7.1. The type of instruments to be erected and commissioned shall be as detailed below:

1.13.7.1.1. Panel mounted Instruments like indicators, recorder, electronic modules etc.

1.13.7.1.2. All types of transmitters like temperature, pressure, flow, level and position feedback transmitters etc.

1.13.7.1.3. Local mounted pressure gauges, DP gauges, thermocouples, RTDs, temperature gauges, temperature switches, pressure switches, DP switches, flow switches and limit switches and flow indicator level switches etc.

1.13.7.1.4. Air filter regulator sets, Air lock off valve, Power cylinders etc.

1.13.7.1.5. Panel/ Control desk mounted Instruments like indicators, recorder, console and electronic modules etc.

1.13.7.1.6. I/P converters and local controllers.

1.13.7.1.7. Special instruments like vibration sensors, proximity sensors, electronic water level indicator, Steam and water analysis system (SWAS), Gas analyser, Coal Flow Monitor, PC based instruments etc.

1.13.7.1.8. Pneumatic operated control valves, trip valves, solenoid valves, and

electrically operated valves. (commissioning only)

1.13.7.2. Prior to installation, all the Instruments (local & remote), I/P converters, etc. shall be calibrated. Similarly, the healthiness of RTDs and thermocouples, limit switches, flow switches, level switches, solenoid valves, air filter regulator, purge meters, etc. shall be checked for proper operation.

1.13.7.3. Unit rate quoted for each instrument shall include calibration, installation, loop checking, commissioning and troubleshooting until satisfactory performance as per operational and system requirement and maintenance till the end of contract period or trial operation whichever is earlier. In case any instrument requires recalibration to achieve the expected performance, the same shall be carried out at no extra cost. If any re-calibration or replacement of instruments and rechecking of cable termination is found necessary during commissioning, the same shall be done at no extra cost. The unit rate shall also cover marking Tag numbers of instruments or Racks, either by paint or a separate tag plate as per BHEL Engineer's directive.

1.13.7.4. Unit rate for erection of pressure/ differential pressure transmitters, gauges, switches, shall include fixing the instruments on the racks / supports along with manifolds, and associated fittings and clamps.

1.13.7.5. Unit rate for Temperature transmitters, I/P converters, Air filter/ Air lock off valves, Purge meters, Rotameters, position transmitter, probes etc shall include fixing the instruments on the racks / supports along with associated fittings and clamps.

1.13.7.6. Unit rate for control room mounted instruments shall cover mounting of instruments on panels / desk wiring, minor grinding on the cut out of panels for proper fixing.

1.13.7.7. Unit rate for erection of Casing temperature thermocouple of turbine/ metal temperature thermocouple (MTM) shall cover laying, dressing and clamping, supply and fixing of tag plates, etc. Welding of MTM pads shall be carried out by mechanical contractor. Necessary tray supports for routing of MTM thermocouples shall be erected as part of tray erection covered in the tender. Proper care shall be taken during cleaning the crevices where MTM Thermocouples are inserted.

1.13.7.8. Unit rate for erection and checking of thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.

1.13.7.9. Unit rate for erection and checking of temperature switches, gauges, thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.

1.13.7.10. If any instrument is to be relocated for reasons not attributable to the contractor, but required for satisfactory performance, the same shall be carried out on extra works basis.

1.13.7.11. Level switches supplied shall be of different types- float type or fixed contact type (Electronic type). The scope of work for float type Level switches shall include fixing of switches on float chambers and fixing of float chambers on stand pipe, providing supports wherever required etc. The scope of work for Electronic type Level

switches includes fixing of Electrode standpipe, Electrodes, Electronic unit, integration of all loose supplied items etc. Any minor modification require to match Float chamber / Electrode standpipe with tapping point same shall be carried out at no extra cost. Uniform unit rate shall be quoted for Erection and commissioning of various types of level switches, irrespective of their type.

1.13.7.12. The unit rate quoted for erection and commissioning of Electronic type Level switches includes fixing of Electrode standpipe, Electrodes, Electronic unit, any minor modification required to match Float chamber/ Electrode standpipe with tapping point, integration of all loose supplied items etc.

1.13.7.13. Unit rate quoted for erection / commissioning of special instruments like, Flame scanner, H.E.A Igniters systems, Vibration monitoring System, Smart wall blowers, Large video screen, Sonic Tube Leak Detection system, Automatic leakage controller for air preheater, SWAS, Flue Gas analyzers, Station LAN / HMI plant management system, PC based instruments, C&I lab, EPABX, Wireless communication, Plant security system, Hart management system, UPS with battery and charger, GPS clock system, Graphical interphase system, Video conference network as per configuration, operator training simulator, computer furniture, etc. shall include installation of all loose items which are not explicitly mentioned, but comes as part of the system, integration of total system and commissioning. Lump sum rate shall be quoted as mentioned in the BOQ. No separate rate shall be payable for loose items including furniture. The quantity of loose supplied items is approximate only. No proportional rate will be applicable for any variation in quantity or for any additional items supplied as part of equipments.

1.13.7.14. If any surface finishing / tapping is required to fix the sensors for Vibration Monitoring System, the same shall be arranged by the contractor at no extra cost.

1.13.7.15. Some of the Flue Gas Analyzers are to be installed at Chimney 65-71 Mtrs as indicated in BOQ. For the erection of associated hardware for these analysers, like cables, trays, GI pipe etc. that are to be routed from the analyser panels at 65-71 Mtrs of Chimney to zero-meter level, payment will be made at twice the unit rate quoted against each item.

1.13.7.16. Canopy shall be provided for field-mounted instruments as per site requirements. Necessary materials like MS Plate shall be provided by BHEL. Rate for fabrication and installation of canopy shall be on tonnage basis.

1.13.7.17. Temporary protection by thermocol, polythene sheet, GI sheets shall be provided by the contractor for safe guarding the instruments against damages. The protective materials shall be supplied by the contractor at no extra cost.

1.13.7.18. In case the Instruments are mounted and supplied along with main equipment and the BOQ calls for Erection & Commissioning, the contractor shall carry out removal, calibration, re-fixing and commissioning of same. Payment shall be made only for removal, calibration, re-fixing and commissioning, in line with rate quoted for

removal, calibration and re-fixing of Instrument of similar type.

1.13.7.19. In case the Instruments are supplied as loose items, and the BOQ calls for removal, calibration, re-fixing and commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made only for Erection and commissioning in line with rate quoted for Erection and Commissioning of Instruments of similar type.

1.13.7.20. The scope of work for panels for TSS System, Sonic Tube Leak Detection System, Furnace Flame Viewing System, Master Clock System, Siemens core turbine panel etc. will be in line with the scope of work of C&I panels covered under clause above in 1.13.2

1.13.8. **SCOPE OF WORK FOR IMPULSE PIPES:**

1.13.8.1. Different types of impulse pipes, like alloy steel, carbon steel, stainless steel of different sizes and thickness shall be supplied with suitable fittings like coupling, sockets, root valves, drain valves, manifold, condensing pots, syphons, tees, bends, nut and tail piece.

1.13.8.2. Unit rate quoted for impulse piping shall include site routing using reducers (at root valve) unions, connector Nuts and tail pieces, sockets, nipples, equal tees, couplings, condensing pots, siphons, root valves, isolation valves cold bending, tig / arc welding. etc., fixing of manifolds and supporting with suitable fixtures and 'U' clamps and painting as per BHEL specification and site engineer's instructions. No separate rate shall be paid for the Impulse pipe fittings. The unit rate also includes supply of U clamps, fasteners, paints, etc. For impulse pipe support materials viz. Angles/ Channels, the rate shall be paid on tonnage basis. The above support materials shall be supplied by BHEL. For scope of painting, please refer Scope of Painting clause. Welding of impulse pipe for High Pressure Lines shall be carried out by High Pressure welder. Suitable root valves will be provided by BHEL on the tapping point wherever required.

1.13.8.3. TIG-welding sets, welding transformer/generator rectifier, Hydraulic bending machines, DPT kits, Hydraulic testing pumps required for pressure testing of impulse pipes shall be arranged by the contractor. Similarly, consumables such as welding electrodes, gas, Tungsten rods, filler wire etc., shall be arranged by the contractor within the quoted rate.

1.13.8.4. For longer route lengths of impulse pipes, the contractor shall provide Tag numbers at appropriate locations as directed by BHEL site engineer.

1.13.8.5. Hydraulic test shall be conducted for all impulse pipes after completion of erection as per site engineer's directive, as part of the work.

1.13.8.6. The contractor shall obtain necessary approval for welding electrodes, filler wire from BHEL welding engineer at site.

1.13.8.7. Impulse pipes Welder shall undergo test and get approval from BHEL welding engineer according to the nature of welding.

1.13.8.8. Pre-heating before welding and post weld heat treatment (stress reliving) as per the standard is in the scope of the contractor.

1.13.9. **SCOPE OF WORK FOR PRE-FABRICATED/ SEMI-FABRICATED LIR/ LIE/ GAUGE BOARDS**

1.13.9.1. If the frame or rack is supplied as a pre-fabricated item like LIR, same shall be erected, grouted and painted as per site requirement.

1.13.9.2. If any frame or support or rack supplied as semi-fabricated item, same shall be assembled at site either by welding or bolting and erected, grouted and painted as per site requirement.

1.13.9.3. Unit rate quoted for such pre-fabricated /semi-fabricated items like LIE/LIR and enclosure shall be on Number basis. Unit rate shall cover installation, grouting, painting and supply of nuts, bolts, anchor fasteners, grouting materials such as cement, sand etc as required. Unit rate shall also include full painting of impulse line fitted and supplied along with LIR/LIE/LGB.

1.13.9.4. Wherever LIR/LGB/LIE are supplied with instruments mounted on them, the rate quoted for LIR/LGB/LIE shall include calibration of all the instruments mounted on them as detailed in the BOQ. However, if the instruments supplied as loose items, the instruments shall be calibrated and mounted on the LIR/LGB/LIE and separate calibration/erection /commissioning charges shall be applicable in line with other instruments erection.

1.13.10. **SCOPE OF WORK FOR COPPER / STAINLESS STEEL TUBES:**

1.13.10.1. Different sizes of copper tubes of different thickness with or without PVC coating shall be supplied in standard lengths of 15 meter Coils and Stainless Steel tube shall be supplied in standard length of 6 meter. The connectors and tees will be of brass / Stainless Steel of different sizes as per site requirement.

1.13.10.2. The unit rate quoted on meter basis shall cover site routing, bending, providing supports, fixing of connectors, unions, valves, tees, etc. and connecting to the instrument airline instruments. The unit rate shall also include providing tag plates on instruments / power cylinders.

1.13.10.3. If copper / Stainless Steel tube length is more than half meter, suitable support shall be provided either by angle or trays. Protective angles to be used for copper tube routing. The support materials shall be supplied by BHEL. For fabrication and

installation of steel supports and frames, the rate shall be as quoted in BOQ for fabrication and installation of steel Tonnage basis.

1.13.10.4. Copper / Stainless Steel tubes shall be clamped with suitable clamping materials. Supply of suitable Aluminium clamps and tag plates are under contractor's scope. The unit rate quoted for laying of copper tube shall cover the supply of clamping materials also. For SADC system copper tube, tag plates shall be provided near instruments, Tees and Power cylinders. Leak test shall be carried out after completion of tubing works as per guidelines.

1.13.11. **SCOPE OF WORK FOR INSTRUMENT AIR LINES (GI PIPES):**

1.13.11.1. Different type of GI pipes of different thickness class shall be supplied along with GI fitting accessories like union, coupling, tee, reducers, elbow, valves, etc.

1.13.11.2. Unit rates on length basis for erection of instrument air lines includes site routing, providing supports, fixing "U" clamps, fixing of loose supplied GI accessories mentioned as above as per the drawings, providing fresh threading as required for jointing with unions, valves and all type of other fittings as required in the system. Unit rate also shall include supply of U clamps, Teflon tapes and bolts, etc.

1.13.11.3. Teflon tapes shall be used for tightening all the joints. No bending, welding etc. is allowed. No separate rate shall be paid for erection of GI fittings / accessories and U clamps.

1.13.11.4. After installation of instrument airlines, the line shall be blown and leak test shall be conducted for all the joints as per the guidelines given elsewhere in this tender.

1.13.12. **SCOPE OF WORK OF ELECTRIC & PNEUMATIC ACTUATORS:**

1.13.12.1. Different types of pneumatic actuators like regulating type, on-off type, of different stroke length shall be supplied. Some of them may be fitted and supplied with main equipment.

1.13.12.2. The unit rate quoted for erection & commissioning scope of electrical and pneumatic actuators includes fabrication and installation of base frame, modification of linkage mechanism wherever required and connecting the same with driven equipment, fixing of all accessories like air sets, Solenoid valves, air lock off valves, limit switches, if supplied loose item as part of power cylinders, replacing the damaged copper tubes or any other accessories like gauges, solenoid valves, limit switches, etc. connecting to airline, and adjusting the stroke length. No separate rate shall be paid for the above works. For all pneumatic and electrical actuators, the necessary Linkage Mechanism shall be supplied by BHEL as part of actuators. No separate rate shall be paid for erection of linkage mechanism. For fabrication and erection of steel supports and frames, the rate shall be paid on Tonnage basis.

1.13.12.3. The link rods have to be adjusted to suit the opening and closing position. This

adjustment has to be repeated number of times till proper operation is obtained. If BHEL site engineer desires to remove the accessories like position transmitters, air locks, positioners, limit switches, solenoids etc. prior to erection either at BHEL stores or at site to avoid damages/pilferage, keep in safe custody and remount the same prior to commissioning, this shall be part of scope of work for power cylinders.

1.13.12.4. For calibration of any Pneumatic Actuator at field, temporary air supply if required shall be arranged by the contractor.

1.13.12.5. In case the power cylinder is supplied in assembled condition along with main equipment and the BOQ calls for Erection & Commissioning of the same, payment shall be made only for commissioning, in line with rate quoted for commissioning of pneumatic power cylinder of similar type.

1.13.12.6. In case the power cylinder is supplied as loose item, and the BOQ calls only for commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made in line with rate quoted for Erection and Commissioning of power cylinder of similar type.

1.13.12.7. Erection and Commissioning of MCCs and laying of power cables to bi-directional electrical actuators shall be done by other agency. The C&I Contractor shall provide necessary support for checking the remote operation of Electric actuators and loop checking of command and feedback signals from DCS to the actuator. The Contractor shall co-ordinate with the other agencies to ensure that all feedback and command signals and settings are made available for bi-directional.

1.13.13. **SCOPE OF WORK FOR CABLES:**

1.13.13.1. BHEL will supply LT, 1.1 kV, armoured/ unarmoured, Copper PVC FRLS, HR PVC insulation, Power, Control and Instrumentation cables of different sizes. The special cables supplied shall be Compensating cable, Ethernet cables and Fibre-optic cable of different sizes and type.

1.13.13.2. The cables covered in the BOQ may be appearing either in BHEL's C&I cable schedule or in BHEL's Electrical cable schedule. The contractor shall lay and terminate all the cables covered in the BOQ, as per directive of BHEL Engineers.

1.13.13.3. The scope of work includes laying & termination of cables, fixing of glands, ferrules, tag plates with necessary numbering and dressing of cable, as per BHEL specification and BHEL engineer's instructions. A composite rate covering laying and termination shall be applicable for cables, except for higher size cables. Separate rate will be applicable for termination of higher size cables and the same will be indicated specifically in the Rate Schedule / price bid / BOQ.

1.13.13.4. Unit rate quoted for cable shall cover laying, termination, drilling of holes on the gland plates of the panels/JB or Enlargement of cable entry holes by tapping or any modification required, fixing of cable glands, fixing of glands, ferrules, termination and providing tag plates and dressing.

1.13.13.5. Unit rates quoted for cabling shall also include supply of clamping/ dressing

materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 2.5 sq.mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed elsewhere in this tender.

1.13.13.6. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, underground, cable shafts etc.

1.13.13.7. Ethernet cables and Fibre optic cables shall be isolated from other cables and laid in a separate cable tray as directed by site Engineer. Wherever required I/O Box shall be installed for Ethernet cable termination and Punch Down crimping tools shall be used for Ethernet cable termination.

1.13.13.8. The scope of work for Fibre Optic cable shall be laying and termination including fixing of fibre optic components and termination kits LIU, space splits cabinets, couplers, grounding etc. Wherever required, the Fibre optic cable shall be laid through HDPE Conduit. Civil works like excavation related to laying of HDPE Conduits underground, if any, is excluded from the scope of this contract.

1.13.13.9. The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. No separate rate shall be paid for cable terminations. For cable joining, if any, separate rate shall be considered on extra works basis.

1.13.13.10. The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if any other agency laid cables of lesser quantity for which no separate trays have been allotted, the contractor shall do clamping along with the cables.

1.13.13.11. Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.

1.13.13.12. During testing and commissioning, if the equipment on which the cables are terminated (including electrical drives) is not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling. The contractor shall promptly depute his supervisor or technicians to assist the commissioning agencies to check the interconnecting cables at no extra cost.

1.13.13.13. Contractor shall carefully plan the cutting schedule for each cable drum in consultation with Engineer such that wastage is minimized and any resultant short lengths can be used where appropriate route lengths are available.

1.13.13.14. If the cables are to be laid on the angles or routed in conduit pipe as per site condition, the unit rate for erection of angles and conduit pipes shall be as per the rate quoted elsewhere in the tender.

1.13.13.15. Any fabrication required at site for cable support shall be carried out at the rate quoted for fabrication.

1.13.13.16. Cable installation shall be properly coordinated at site with other services and

wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services any such adjustment shall be done with the approval of Engineer.

1.13.13.17. The approximate number of termination for the purpose of estimation to be assumed as follows: The average RUN length shall be considered as 150 metres. However, for 10% of the 2 pair and below, the average length shall be considered as 30 metres.

1.13.14. **SCOPE OF CABLE TERMINATION**

1.13.14.1. Laying and termination of all cables including Ethernet, fibre optic cable is part of the scope.

1.13.14.2. The scope of termination shall include termination of cables on various panels / JBs / Push buttons / equipment etc. including those installed by other agencies.

1.13.14.3. Re-termination, if required during testing/ commissioning shall be carried out without additional cost.

1.13.14.4. Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant, long enough to over pass conductor insulation and properly sized.

1.13.14.5. Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.

1.13.14.6. Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.

1.13.14.7. After cable terminations, the debris shall be removed then & there.

1.13.14.8. Also refer clause 1.13.13.2 above

1.13.15. **SCOPE OF WORK FOR CABLE TRAYS/ CONDUITS/ FLEXIBLE CONDUITS/ HOSE:**

1.13.15.1. **CABLE TRAYS**

Scope of cable tray works covers erection of various sizes of perforated trays with accessories mostly for branch trays in Power House building. All type of cable trays including, standard trays accessories shall be supplied by BHEL.

The scope of work for cable trays shall be as follows:

a) Different Junction The unit rate for erection of trays shall be on meter basis. The unit rate quoted for erection of tray shall also include erection of all tray accessories such as elbow, cross, Tees, bends such as vertical and Horizontal, reducers, coupler plates/fixing plates, anchor bolts, fasteners etc.

b) For routing of trays standard tray accessories supplied by BHEL shall be used. However, if above standard tray accessories are not supplied, the same

shall be fabricated and installed at no extra cost.

c) If standard tray accessories like Tees, Reducers, Bends, cross etc. require any modification to suit the tray routing, the same shall be carried out at no extra cost.

d) The unit rate quoted for trays shall also cover making of offsets by means of cutting standard tray sections and inserting suitable trays to match with the existing arrangement.

e) Site fabrication / modification of trays or on tray accessories will be paid on extra work basis.

f) The contractor shall quote a uniform rate on meter basis for erection of trays and Tray accessories like Tees, Reducers, Bends, cross etc.

g) Tray covers are to be erected after completion of cable laying and no separate payment will be made for fixing these covers. GI strip clamps are to be used for fixing the tray covers.

h) Welded Joints of trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS 3043. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.

1.13.15.2. **RIGID & FLEXIBLE CONDUITS**

a) Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe/flexible conduits supplied by BHEL shall be used. Unit rate shall be paid on running meter basis.

b) Unit quoted on meter basis for flexible conduit includes drilling of the holes on the plates, fixing of the end connectors, providing suitable supports and fixing tag marks wherever specified as required by BHEL. No separate payment will be made for fixing of end connectors.

c) Unit quoted on meter basis for GI rigid conduit includes supply of suitable clamps / fasteners / tag plates etc.

d) The scope of work includes drilling of holes on the plates, fixing of end connectors, providing suitable supports and fixing tag plates as required by BHEL. Supply of suitable clamps, fasteners and tag plates are covered in the unit rate.

1.13.16. **SCOPE OF WORK FOR JUNCTION BOXES/CJCBs /PUSH BUTTON BOXES:**

1.13.16.1. Different Junction Boxes/ Push Button boxes with gland plates shall be supplied by BHEL.

1.13.16.2. The unit rate quoted for erection of junction boxes/push button boxes shall cover the following also.

1. Providing necessary supports
2. Drilling of bottom gland plates for cable glands as required
3. Painting the tag Nos. or fixing a separate tag plate on junction boxes/push button boxes.
4. Minor chipping, grouting as required for mounting the JBs/PB
5. Supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button.
6. Closing all unused holes on the gland plates using grommet or any other suitable materials.
7. Any modification like replacement of terminals, enlarging gland holes etc. that may be required to accommodate power cables.

1.13.16.3. All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.

1.13.16.4. For CJCBs/ RJCBs, the rate for Junction Boxes similar size, as per Rate Schedule, will be applicable.

1.13.16.5. For fabrication and fixing of supports/Frame, rate shall be paid on tonnage basis.

1.13.17. **SCOPE OF WORK FOR FABRICATION & ERECION OF STEEL MATERIALS:**

1.13.17.1. Scope of steel fabrication and installation covers, fabrication and installation of various type of supports for cable tray, instruments, impulse pipes, GI pipes, support angles for copper tubing, mounting frames for JB, Control Box/Panel, local PB Stations, canopy for local instruments and local instrument rack etc. wherever required.

1.13.17.2. The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL. Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers.

1.13.17.3. Immediately after fabrication, primer shall be applied to prevent corrosion. The installation shall be carried out only after applying the primer as detailed in painting clause.

1.13.17.4. All fabricated steel materials shall be painted as detailed in the scope of painting.

1.13.17.5. A composite rate shall be quoted for fabrication and installation of steel, on tonnage basis. The above rate shall include supply of paints and painting, grouting and grouting material as required.

1.13.18. **SCOPE OF EARTHING**

1.13.18.1. The scope of earthing covered in this contract is above ground earthing i.e. equipment earthing. Scope of earthing covers earthing of field Instruments, JBs, Branch trays, LIR/LIE, JB, Push Button boxes etc. All DCS and its accessories, PLC/Instrumentation panels/systems etc, shall be earthed to a separate

Electronic earth grid.

1.13.18.2. Different type of earthing materials shall be supplied and same shall be erected as per site requirement.

1.13.18.3. The scope of work shall include supply of fasteners, lugs, minor civil works etc.

1.13.18.4. All connections from the equipment to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the contractor at site.

1.13.18.5. The unit rate shall be quoted for earthing on metre basis. The rate shall cover supply of fasteners, lugs, minor civil works, painting the welded joint etc.

1.13.19. **SCOPE OF CALIBRATION:**

1.13.19.1. The contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, recorders, Indicators etc. that will be supplied along with equipments mounted in or in loose.

1.13.19.2. Contractor has to calibrate all the instruments covered in their scope at site with their own calibration and testing equipment's under the supervision of BHEL / Customer Engineers and maintain the calibration records as per the BHEL prescribed format / relevant FQP formats.

1.13.19.3. All testing Instruments / Equipment deployed for calibration shall be calibrated before taking into service. All testing instruments shall have calibration certificate issued by recognized /accredited agencies. A copy of calibration certificate shall be submitted to the engineer for his verification and approval.

1.13.19.4. BHEL shall provide vendor supports for proprietary type of microprocessor – based instruments, protective relays, which requires software loading and programming etc. However overall responsibility lies with contractor and contractor shall provide all supports like manpower, standard T&P, Instruments etc., for calibration and testing of above proprietary instruments.

1.13.19.5. If BHEL is unable to provide or arrange vendor support for proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by the outside agency shall be reimbursed by BHEL. However, if above such calibrator is available with BHEL at site, the calibration shall be carried out by the contractor with in quoted rate.

1.13.20. **TURBINE SUPERVISORY CONTROL SYSTEM (TSS): For Main Turbine:**

1.13.20.1. The indicative scope of works for TSS for Main Turbine is as follows: Collection of materials from stores, Preparation of mounting surface and mounting arrangement to suit the surface of the machine, Installation of JBs, Laying &

Terminations of Instrumentation cable from Local JB and Cabinet, Laying and termination of Power cable to TSS panel, Laying and termination of ethernet cables (as applicable), Laying and Termination of FO cables. (Mounting sensors on the Machines, Laying and termination of cables between sensors to Local JB, Pre-commissioning check, energizing cabinets & PC (as applicable), Commissioning, Installation of software packages, handing over to the end-user are in the scope of OEM).

1.13.21. **MEASUREMENTS & WASTAGE & CUTTING ALLOWANCES:**

1.13.21.1. For all payment purposes, measurement shall be made on the basis of the execution of drawings/physical measurements. Physical measurements shall be made by the contractor in the presence of the Engineer.

1.13.21.2. The measurement for cable, impulse pipes/tubes, GI pipe, conduits, flexible conduits, trays etc. shall be made on the basis of length actually laid.

1.13.21.3. All the surplus, scrap and serviceable materials, out of the quantity issued to the contractor shall be returned to BHEL in good condition and as directed by the engineer.

1.13.21.4. All materials returned to stores should carry an aluminium tag indicating the size and type. More than 5 metres length termed as serviceable material and shall be returned size wise and category wise to the owner's stores/yard. Cable of serviceable length being returned to the stores in drums shall have their free ends sealed and the balance lengths on the drum(s) shall be noted and certified by the Engineer-in-charge. This shall be applicable only for the purpose of accounting the cables issued for installation.

1.13.21.5. While carrying out material reconciliation with contractor, all the above points will be taken into account. All serviceable material returned by the contractor shall be deducted from the quantities issued for the respective sizes and categories and the balance quantity(ies) will be taken as the net quantity(ies) issued to the contractor. Material appropriation shall be done and allowable scrap quantity calculated as per wastage allowance specified below. Any scrap / wastage generated by the contractor in excess of the allowable percentage shall be charged at the rates decided by the Engineer whose decision shall be final and binding on the contractor.

1.13.21.6. For all site-fabricated steel items such as supports, racks, frames, Canopy etc. physical measurement shall be made and then converted to tonnage. For steel material supplied to the contractor, all scrap shall be returned to BHEL stores with due accounting.

1.13.21.7. Every month the contractor shall submit an account for all the materials issued to him by BHEL in the standard proforma prescribed for this

purpose by the site in charge.

1.13.21.8. The cable take off from drums shall be planned strategically such that jointing in the run of cables and wastage are avoided. For this purpose the exact route length between various equipment/panels as per the cable schedule shall be measured and the route length recorded before laying of the cables. Depending upon the route length the type of cable required for various destinations, the cable drums shall be suitably selected for cable laying. Jointing of cable, if any shall be approved by the BHEL engineer. All the cut pieces / bits of cables which are not used / unused shall be returned to the BHEL stores for accounting towards wastage. The cables damaged by the contractor shall have to be replaced by the contractor at his own cost.

1.13.21.9. The erection contractor shall make every effort to minimize wastage during erection work. The wastage allowances as permissible for various items are indicated in the following table. Cutting and wastage allowance shall be computed on the lengths and weight of materials actually used, measured and accepted. In any case, the wastage shall not exceed the following limits.

Sl. No	Item	% wastage on issued quantity
a)	Fabrication steel	2
b)	Each size of power cables	1
c)	Each size of control / instrumentation cables	2
d)	Impulse pipe / tubes / GI pipes / copper tube	1

NOTE:

(i) Salvageable scrap shall mean lengths of pipes, multi core cables, other cables etc., that can be used one time or other at a later date and normally they are recovered from the cut-pieces of tubes, pipes, multicore cables, cables etc.

(ii) Non - Salvageable scrap means the lengths of tubes, pipes, multicore cables, cables etc., and they are from cut-pieces of tubes, pipes, multicore cables, cables etc., that cannot be used at all one time or other.

VOLUME-IA PART – I CHAPTER – XIV
PROGRESS OF WORK

The scope of the work will comprise of but not limited to the following:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.14.1. Refer forms F -14 and F-15 of volume I D (Forms & Procedure) of volume -I book-II. Plan and review will be done as per the formats.

1.14.2. The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

1.14.3. It is the responsibility of the contractor to provide all relevant information on a regular basis regarding erection progress, labour availability, equipment deployment, testing, etc.

1.14.4. During the course of erection, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.

1.14.5. Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

1.14.6. Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.

1.14.7. The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out on each weld and maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required.

1.14.8. The contractor shall submit daily, weekly and monthly progress reports, manpower

reports, materials reports, consumables (gases / electrodes / ferrules / lugs) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL formats.

1.14.9. The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

1.14.10. The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

1.14.11. The monthly report shall be submitted at the end of every month as a booklet and shall contain the following details:-

a. Colour Progress photographs.

b. Erection progress in terms of tonnage, percentage of work completion, welding joints, radiography, stress relieving, etc., completed as relevant to the respective work areas against planned.

c. Site Organization chart of engineers & supervisors as on the last day of the month with further mobilization plan

d. Category- wise man hours engaged during the previous month under the categories of fitters, welders, riggers, khalasis, grinder-men, gas-cutters, electricians, crane operations, store keepers, lab technicians, helpers, security etc. Data shall be split up under the work areas like Boiler (pressure parts, structures) Rotating machines, Electro static precipitator, Insulation, Piping, Steam turbine, Condenser, Generator etc.

e. Consumables report giving consumption of all types of gases and electrodes during the previous month.

f. Availability report of cranes & T&Ps

g. Safety implementation report in the format

h. Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

1.14.12. The contractor to reflect actual progress achieved during the month and will be submitted to BHEL, so that slippages can be observed and necessary action taken in order to ensure that the situation does not get out of control will update the construction schedule forming part of this contract each month.

VOLUME-IA PART – I CHAPTER- XV
TESTING AND COMMISSIONING

TESTING, PRE – COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

The scope of the work will comprise of but not limited to the following:

1.15.1. The scope of commissioning works covers commissioning of all instruments covered in the BOQ including loop checking and establishing the operation of instruments / systems to meet plant commissioning / operation. The contractor shall be responsible for overall commissioning of all the instruments and systems covered in the BOQ.

1.15.2. Scope of pre-commissioning / commissioning starts with the commissioning of various equipment erected by the contractor and making them available to commission various materials / systems and main power plant. The scope of work of various commissioning activities of the main plants is referred below:

a. Trial run of various equipment.
b. Light up of boiler.
c. Boiler EDTA / Chemical Cleaning.
d. Turbine barring gear.
e. Steam blowing of piping.
f. Turbine rolling.
g. Safety valve floating.
h. First synchronization
i. Trial Operation / Full load.

1.15.3. The above activities, tests, trial runs may have to be repeated till satisfactory results are obtained and also to satisfy the requirements of customer / consultant / statutory authorities like boiler inspector, electrical inspector, TAC, etc.

1.15.4. The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.

1.15.5. The pre-commissioning activities of the main power plant will start with run of various equipment prior to light up of boiler and commissioning operations shall continue till the unit is handed over to customer. The contractor shall simultaneously start commissioning activities for the equipment erected to match with the various milestone activities of commissioning programme of the project.

1.15.6. Contractor shall arrange experienced commissioning engineers, supervisors including electrician / instrument mechanics in each area to be associated with BHEL commissioning staff. Contractor shall earmark separate manpower for

various commissioning activities. The manpower shall not be disturbed or diverted. It shall be specifically noted that above employees of the contractor may have to work round the clock along with BHEL commissioning engineers involving considerable payment of overtime, which forms part of Contractor's Scope.

1.15.7. The mobilization of these commissioning groups shall be such that planned activities are taken up in time and also completed as per schedule and the work undertaken round the clock if required. It is the responsibility of contractor to discuss on day to day / weekly / monthly basis the requirement of manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and necessary recoveries with overhead cost will be made from the bills of the contractor.

1.15.8. After erection of various equipment, prior to commissioning and after commissioning, protocols have to be made with BHEL's customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers.

1.15.9. For electrical works, 415 volts and above, the contractor has to bring qualified electricians and the total work has to be certified by electrical license holder. The expenditures towards work certificate and all statutory requirements connected towards the high voltage system shall be borne by the contractor.

1.15.10. In case any rework / repair / rectification / modification / fabrication etc. is required because of contractor's faulty erection which is noticed during commissioning at any stage, the same has to be rectified by the contractor at his cost. If during commissioning, any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.

1.15.11. During commissioning activities and carrying out various tests, if any of the instruments has to be temporarily erected and commissioned to suit the commissioning activities, the contractor has to carry out the erection of the same. After completion of activities the temporary systems have to be removed and returned to stores and no extra rate shall be paid for this.

1.15.12. All the T&P instruments required for commissioning are to be arranged by the contractor. However, any special instruments, which are of proprietary nature, shall be arranged by BHEL.

1.15.13. It shall be the responsibility of the contractor to arrange and complete all the testing, pre-commissioning and commissioning activities for the particular equipment as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. All the above will be witnessed by the BHEL engineers and reports signed shortly. Contractor shall follow checklist of BHEL and testing & commissioning activities shall be carried out in accordance with the checklist.

1.15.14. The scope of commissioning shall also cover the commissioning of the equipment / drives erected by the mechanical contractors. (as detailed in the BOQ)

1.15.15. The mobilization of testing team shall be planned in time and shall be undertaken round the clock. The contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost shall be recovered from contractor.

1.15.16. Prior to commissioning and after commissioning, protocols have to be made with BHEL / customer. The formats shall be given by BHEL and have to be printed by the contractor in adequate numbers. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractor's Scope

1.15.17. Any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at his cost.

1.15.18. Commissioning Engineers also shall be identified separately for each package and the minimum requirement shall be as indicated below (Requirement given below is per Package).

	Boiler	TG	Station C&I	BOP and Misc	TOTAL
Engineer (C&I)	1 No.	1 No.	1 Nos.	1 nos	4 Nos.
Supervisor (C&I)	3 Nos.	3 Nos.	3 Nos.	3 nos	9 Nos.
Technician(C&I/ Electrical)	8 Nos.	6 Nos.	8 Nos.	8 nos	30 Nos.

1.15.19. The above commissioning group shall be identified at the Pre-commissioning and commissioning time. The above commissioning group shall have knowledge of various systems referred in the tender and also should have adequate experience.

1.15.20. The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor. Besides the above, there will be separate engineers for Planning, Safety and Quality. For all practical purposes, each of the above In-charges shall be provided with a PC and good communication facilities.

1.15.21. If the contractor fails to deploy the above Engineer / Supervisor / Technician at appropriate time of commissioning, BHEL Engineer will have the right to withhold the payment towards commissioning activities as defined in terms of payment.

1.15.22. T & P / instruments required for testing are to be arranged by the contractor.

1.15.23. All commissioning / testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above shall be witnessed by BHEL engineer and the reports signed jointly.

1.15.24. The scope of commissioning assistance to be provided by the contractor shall cover the equipment / drives erected by the mechanical contractors as detailed in the BOQ.

1.15.25. **Scope of commissioning of equipment erected by the mechanical contractor**
The scope of commissioning assistance to be provided by the contractor will cover the equipment / drives erected by the mechanical contractors as detailed in the BOQ.

The scope of work also includes collecting the replacement instruments / parts from BHEL / customer stores, stockyard etc.

Separate group shall be identified for commissioning. The above group shall be available right from Trial run to full load operation including shift operation.

1.15.25.1. **PNEUMATIC (ALL TYPES OF VALVES AND POWER CYLINDERS)**

a) Calibration and checking of instruments mounted on the actuators and setting stroke length of the actuator.
b) Servicing of positioners, position transmitters, limit switches, solenoid valves, air lock-off valves, removing/replacement of defective components, copper tubes etc., if necessary.
c) If the actuator is to be removed for attending to any mechanical problems, removing of copper tubes, cables etc. reconnecting and re-commissioning of the actuators is to be done.
d) Testing and checking the remote / local operation in Auto as well as Manual mode.
e) Fixing of instruments if supplied as loose items.
f) Attending to any defects till the contract period.

1.15.25.2. **FLOW METERS / SWITCHES**

a) Checking the calibration and servicing if required.
b) Setting the alarm value
c) Replacement of defective components if any

1.15.25.3. **LIMIT SWITCHES & LEVEL SWITCHES**

a) Checking the operation
b) Replacing defective components if required

1.15.25.4. **SOLENOID VALVES**

a) Checking the healthiness of coil

b) Checking the operation

c) Replacement of defective components if required.

1.15.25.5. **TEMPERATURE ELEMENTS (MOTORS AND GENERATORS WINDING AND BEARING)**

a) Checking the healthiness

b) Replacement of defective element (only for bearing)

1.15.25.6. **DIRECT WATER LEVEL GAUGES (REMOTE & LOCAL)**

a) Checking the calibration

b) Fixing of bulbs and extending Power supply

c) Replacing defective components

1.15.25.7. **INSTRUMENTS MOUNTED ON THE EQUIPMENTS / SKIDS / PANELS**

Scope of work covers removal, re-calibration, re-fixing, and re-termination of cables, checking the continuity, replacing any defective parts or replacing the total instrument, if required.

1.15.26. All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above will be witnessed by BHEL engineer and the reports signed jointly.

1.15.27. All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications. Specialized test equipment, if any, shall be provided by BHEL / its client free of hire charges. However, contractor has to take proper care of the equipment issued to him.

1.15.28. All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at his cost.

1.15.29. It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre-commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

1.15.30. It shall be specifically noted that the contractor and employees of the contractor may have to work round the clock during the pre-commissioning, commissioning and post- commissioning period along with BHEL Engineers / customer officials. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers / supervisors.

1.15.31. In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at his cost. If any equipment / part is required to be inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.

1.15.32. Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre- commissioning and commissioning programmes made to achieve the schedule agreed with customer.

1.15.33. After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary consumables, hand tools and supervision as part commissioning assistance till handing over of sets to customer.

1.15.34. The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

1.15.35. The contractor shall carryout any other test not listed in the tender as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

1.15.36. It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications including for trial operation, even if commissioning of equipment is delayed due to reasons not attributable to the contractor

VOLUME-IA PART- I CHAPTER-XVI
PAINTING

The scope of the work will comprise of but not limited to the following:

1.16.1. **FINAL PAINTING**

1.16.1.1. The scope of work shall also include supply and application of final painting of all the components, other equipment etc., erected under the scope of this tender. The painting shall be as required and specified in the painting schedule which forms the part of this tender book.

1.16.1.2. The quoted rate / price shall be inclusive of supply and application of final painting of all the erected equipment as per the painting specifications of customer / BHEL like supports, racks, frames, canopy, LIE / LIR / LGB, impulse pipes etc. carried out by the contractor. Painting shall be carried out for any bare copper tube also.

1.16.1.3. In the case of steel fabricated items, raw steel after fabrication has to be surface cleaned and subsequent painting to be carried out.

1.16.1.4. The scope also includes supply of paints, primers, tools/consumables like brushes, rollers, emery papers, thinner etc., at no additional cost.

1.16.1.5. All the exposed metal parts of the equipments including busducts, transformers,, structures, etc., wherever applicable after installation unless otherwise specified the surface protected, are to be first painted with at least one coat of suitable primer and required number of finish coats as indicated in the Painting Specification which matches the shop primer paint used, after thoroughly cleaning the dust, rust, scales, grease oil, and other foreign materials by wire brushing scrapping and chemical cleaning and the same being inspected and approved by BHEL engineers for painting. Afterwards the above parts shall be finished with as per the instructions of BHEL/Customer official.

1.16.1.6. All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over.

1.16.1.7. Paint shall be applied by brushing or by spray painting as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimal.

1.16.1.8. If needed and insisted either by BHEL / Customer in certain cases, spray painting has to be carried out within the Quoted rates. Spray painting gun and compressed air arrangement has to be made by the contractor himself.

1.16.1.9. Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.

1.16.1.10. Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted. Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.

1.16.1.11. The scope of painting includes application of colour bands, lettering the names of the systems equipments; tag Nos of valves, marking the directions of flow and other data required by BHEL within the quoted rate.

1.16.1.12. All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.

1.16.1.13. Finish coat paint, No. of coat and DFT shall be as indicated in the painting specification enclosed in this tender / relevant BHEL document/ customer's specifications. The painting specification which is forming part of this tender as in TCC shall be used as guidelines to be followed.

1.16.1.14. The actual colour to be applied shall be approved by the customer before starting of actual painting work.

1.16.1.15. Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the BHEL / Customer approved agencies only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities.

1.16.1.16. No paint shall be applied when the surface temp is above 55 deg. Centigrade or below 10 deg. Centigrade, and when the humidity is greater than 90% to cause condensation on the surface or frost / foggy weather.

1.16.1.17. Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.

1.16.1.18. Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.

1.16.2. **PRESERVATION / TOUCH UP PAINTING**

1.16.2.1. Due to atmospheric conditions erected materials are likely to get rusted more frequently. It is the responsibility of the contractor to preserve the erection materials drawn from stores for erection till these are commissioned and handed over to customer. The required consumables for this purpose like paint, thinner, rust converter compound (Ruskill or Ferropro) or any other equivalent shall be arranged by bidder. However, the contractor should also arrange other consumables like wire brushes, emery paper, cotton waste, cloth etc., at their cost. The contractor should ensure that the materials are not rusted on any account till they are handed over to customer. The decision of the BHEL Engineer is final with regard to frequency of application of paint and rust converter compound.

1.16.2.2. Mostly the equipment / items/ components will be supplied with one coat of primer paint and one coat of finish paint. However, during storage and handling, the same may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour. Besides above two coats of approved primer paint is to be applied on all the bare / unpainted surfaces. Touch up painting is generally required for trays, control panels.

1.16.2.3. All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.

1.16.2.4. Contractor shall carryout cleaning and preservation / touch up painting for the materials / equipments under this tender specification right from pre- assembly stage to till the equipment is cleared for final painting.

1.16.2.5. Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with touch up coat of red oxide primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.

1.16.2.6. Equipment / items/ components supplied during storage and handling, may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour.

VOLUME-IA PART-II CHAPTER-I

CORRECTIONS / REVISIONS IN SPECIAL CONDITIONS OF CONTRACT, GENERAL CONDITIONS OF CONTRACT AND FORMS & PROCEDURES

Sl. No.: 01

Following Clauses in General Conditions of Contract (GCC) are modified/ revised/ added:

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
1.	GCC Clause 1.9.1, Sl. No. (ii)	The following mode of deposit, Sl. No. (e) is added: e) Insurance Surety Bonds
2.	GCC Clause 1.10.3, Sl. No. (vi)	**The following Clause, Sl. No. (vi) is deleted**: Security deposit can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required security deposit is collected. However, in such cases at least 50% of the required Security Deposit, including the EMD, should be deposited in any form as prescribed before start of the work and the balance 50% may be recovered from the running bills as described above
3.	GCC Clause 1.10.3, Sl.No.(vii)	The following mode of deposit, Sl. No. (vii) is added: e) Insurance Surety Bonds
4.	Note mentioned under the GCC Clause 1.10.3	Note mentioned under GCC Clause 1.10.3 is revised as below: Note: **(1)** BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith. **(2)** In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate +4%) for the delayed period, shall be submitted by the bidder.
5.	GCC Clause 1.10.8	**GCC Clause 1.10.8 is revised as below:** Bidder agrees to submit security deposit required for execution of the contract within the time period mentioned. In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate+4%) for the delayed period, shall be submitted by the bidder. Further, if security deposit is not submitted till such time the first bill becomes due, the amount of security deposit due shall be recovered as per terms defined in NIT / contract, from the bills along with due interest
6.	GCC Clause 2.22.1	**GCC Clause 2.22.1 is revised as:** Retention Amount shall be 5% of the Contract Value and shall be furnished through BG in line with clause 1.12 of GCC before payment of first RA Bill. The validity of the said BG shall be initially for the contract period & shall be extended, if so required, up to

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		acceptance of final bill. In case of increase in contract value, additional BG for 5% of differential amount shall be submitted by Contractor before payment of next RA Bill due. Retention Amount can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required retention amount is collected. In case, contractor opts cash deduction from RA bills in the beginning & subsequently offers to submit BG later on, then refund of deducted retention amount may be permitted against submission of BG for 5% of the Contract Value.
7.	New Clause for "Breach of Contract, Remedies and Termination" is added in place of existing clause of Risk & Cost (i.e. 2.7.2.1 to 2.7.3)	**1.Clause 2.7.2 and 2.7.3 are revised as:** **2.** **3.2.7.2 <u>Breach of Contract, Remedies and Termination</u>** **2.7.2.1** BHEL shall terminate the contract after due notice of a period of 14 days in any of the following cases, which if not rectified/ improved within the time period mentioned in the notice, then, 'Breach of Contract' will be considered to have been established: i). Contractor's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution. ii). Withdrawal from or abandonment of the work by contractor before completion of the work as per contract. iii). Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor. iv). Repeated failure of contractor in deploying the required resources, to comply the statutory requirements etc. even after given by BHEL is writing. v). Strike or Lockout declared is not settled within a period of one month. vi). Termination of Contract on account of any other reason (s) attributable to Contractor. vii). Assignment, transfer, subletting of Contract without BHEL's written permission. viii). Non-compliance to any contractual condition or any other default attributable to Contractor. **2.7.2.2 <u>Remedies in case of Breach of Contract is established</u>** In case 'Breach of Contract' is established, Security Deposit and Retention Amount shall be encashed/ forfeited. This is without prejudice to BHEL's right to levy of liquidated damages, debarment

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		etc. which shall be applied as per the provisions of the contract. Sequence of recovery to be made in case of breach of contract is established, is as below: a) In case the value of Security Deposit & Retention Amount, available for the Contract, is less than 10% of the Contract Value, the balance amount shall be recovered from dues available in the form of Bills payable to contractor, BGs against the same contract etc. b) Demand notice for deposit of balance recovery amount shall be sent to contractor, if funds are insufficient to effect complete recovery against dues indicated in (a) above. c) If contractor fails to deposit the balance amount to be recovered within the period as prescribed in demand notice, following action shall be taken for balance recovery: i) Dues payable to contractor against other contracts in the same Region shall be considered for recovery. ii) If recovery cannot be made out of dues payable to the contractor as above, balance amount to be recovered, shall be informed to other Regions/Units for making recovery from the Unpaid Bills/Running Bills/SD/BGs/Final Bills of contractor. iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor. Note: 1) In addition to above, levy of liquidated damages, debarment, termination, short-closure etc. shall be applied as per provisions of the contract. 2) If tendering is done for the balance work, the defaulted contractor (including all the members/partners in case of JV/ partnership firm) shall not be eligible for either executing the balance work or to participate in the tender(s) for executing the balance work. **2.7.3** In case Contractor fails to deploy the resources as per requirement informed by BHEL in writing to expedite the work, BHEL can deploy own/hired/otherwise arranged resources and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.
8.	GCC Clause 2.7.7	**GCC Clause 2.7.7 is revised as:** BHEL may permit or direct contractor to demobilize and remobilize at a future date as intimated by BHEL in case of following situations for reasons other than Force majeure conditions and not attributable to contractor: i) suspension of work(s) at a Project either by BHEL or Customer,

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		or ii) where work comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than three months 4. In such cases, charges towards demobilization and remobilization shall be as decided by BHEL after successful remobilization by contractor at site, and decision of BHEL shall be final and binding on the contractor. After remobilization, all conditions as per contract shall become applicable. In case Contractor does not remobilize with adequate resources or does not start the work within the period as intimated, then BHEL reserves the right to terminate the contract and effect remedies under Clause 2.7.2.2. Duration of the contract/time extension shall be revised suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.
9.	GCC Clause 2.11.3	**GCC Clause 2.11.3 is revised as:** However, if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take under clause 2.7.2 of GCC i.e. "Breach of Contract, Remedies and Termination".
10.	GCC Clause 2.19.1	**GCC Clause 2.19.1 is revised as:** The contractor will be fully responsible for all disputes and other issues connected with his labour. In the event of the contractor's labour resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of one month, it may be considered as 'Breach of Contract' under Clause 2.7 and the remedies under Clause 2.7.2.2 may be executed, at the discretion of BHEL.
11.	GCC Clause 2.24.1	**GCC Clause 2.24.1 is revised as:** Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of Twelve months from the date of commencement of guarantee period as defined in Technical Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty erection detected during the guarantee period. In the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works, by itself, without prejudice to any other rights and recover the cost incurred for the same along with 5% overheads from the Security Deposit.

Sl. No.: 02

In addition to The EARNEST MONEY DEPOSIT (EMD) clause 1.9 and The SECURITY DEPOSIT (SD) clause 1.10 published in General Conditions of Contract (Volume I Book II) following is added for FDR

1. FDR should be Lien marked in favour of M/s BHEL.
2. Bank issuing FDR should agree to the following conditions and submit duly signed letter addressed to BHEL, confirming the following points:

a) There is no Lock in Period for Encashment of the Said FDR

b) The amount under the Said FDR would be paid to BHEL-PSSR on Demand, at any point of Time before, or upon Maturity, without any reference to the …… (Contactor Name).

c) Encashment whether premature or otherwise would not require any clearance from any other authority /Person.

d) FDR will be auto renewed for such period/s initially mentioned in the FDR and the intimation of Such renewal shall be sent to BHEL, PSSR and …… (Contractor), immediately after the renewal.

e) FDR will not be closed, Encashed, Changed or Discharged without the Written permission/Confirmation from M/s BHEL PSSR.

f) Bank to acknowledge and agree that the Lien created on the FDR shall be in Force until M/s BHEL PSSR, gives a Discharge Letter in this regard.

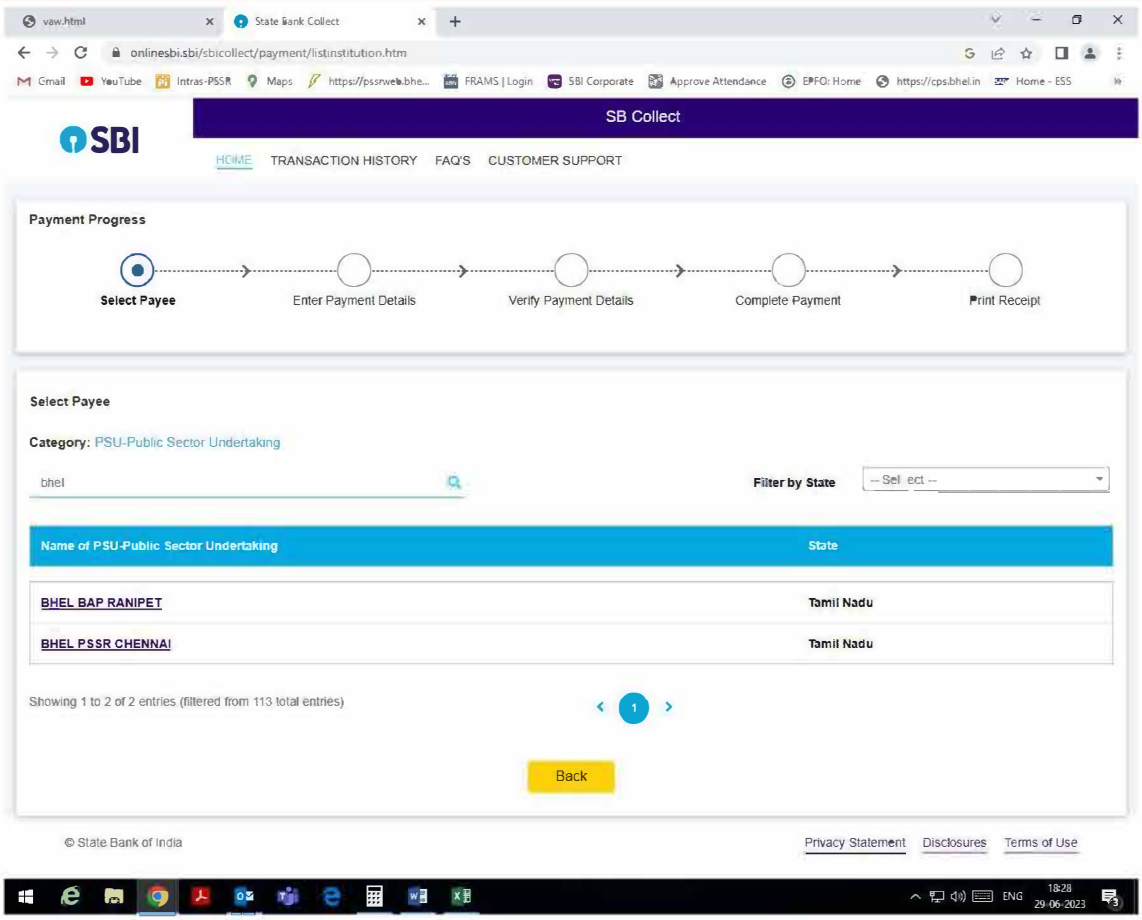
Sl. No.: 03

Detailed Instruction for EMD / Security deposits through SBI e-collect:

Step 1: Vendors may visit SBI collect website, the URL of which is https://www.onlinesbi.sbi/sbicollect where they get the home page with various categories of institutions.

Step 2: Select PSU - Public Sector Undertakings – leading to a page with list of PSUs

Step 3: Type BHEL and search, they get to see all BHEL divisions wherein they shall select BHEL PSSR Chennai. The screen shot of the same is given below.



Step 4: Select EMD receipts. Having selected the Payee in the Payment Progress, it will lead to the payment details – a drop down list of values. From that list, vendors shall select EMD receipts. Upon clicking the entry EMD receipts, a form will open asking for the remitters details and the details of the tender.

Step 5: Confirm details and pay

Fill in all the details correctly, verify the details, and complete the payment as it is leading to the payment gateway.

Step 6: Take a printout on completing the payment and enclose the copy of the same along with the bid submission. Store the copy of receipt for future reference.

Sl. No.: 04

VOID

Sl. no 05.
VOID

Following Clauses are modified in the Special Conditions of Contract (SCC)

Sl. No.: 06
Clause No. 10.5 on RA Bill Payments, in Special Conditions of Contract (SCC), Volume- IB, Book- II, is revised as under:

"The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc., and other dues in the meanwhile."

Sl. No.: 07

SCC Cl. No.	Existing Clause	Modified Clause
4.2.1.7	In the event of contractor failing to arrange the required tools, plants, machinery, equipment, material or non-availability of the same owing to breakdown, **BHEL will make alternative arrangement at the risk and cost of the contractor……**	In the event of contractor failing to arrange the required tools, plants, machinery, equipment, material or non-availability of the same owing to breakdown, **BHEL can deploy own / hired / otherwise arrange resources and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC……**
4.2.2.5	…… In case of any lapses on the part of the contractor, BHEL at its own discretion shall get the servicing / repair of equipment done **at the risk and cost of the contractor along with BHEL overheads**……..	……In case of any lapses on the part of the contractor, BHEL at its own discretion shall get the servicing / repair of equipment done **and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC**……..
5.14	…….If at any time, it is found that the contractor is not in a position to deploy the required engineers / supervisors / workmen due to any reason, BHEL shall have the option to make alternate arrangements **at the contractor's risk and cost. The expenditure incurred along with BHEL overheads thereon shall be recovered from the contractor.**	……..If at any time, it is found that the contractor is not in a position to deploy the required engineers / supervisors / workmen due to any reason, BHEL shall have the option to make alternate arrangements **and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.**
6.1.11	If the material belonging to the contractor are stored in area other than those earmarked for his operation the engineer will have the right to get it moved to the area earmarked for the contractor **at the contractor's risk and cost**	If the material belonging to the contractor are stored in area other than those earmarked for his operation the engineer will have the right to get it moved to the area earmarked for the contractor **and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.**

VOLUME-IA PART – II CHAPTER 2
DATASHEET

2.2.1.	**SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS**	
2.2.1.1.	**Clamps**	
	Material & Type	Nylon self-locking ties aluminium strips clamps as mentioned in Chapter-III of Technical Conditions of Contract (Volume-IA Part-I in Book-I)
	Sizes	To meet the requirements mentioned in Chapter-III of Technical Conditions of Contract (Volume-IA Part-I in Book-I)
2.2.1.2.	Ferrules	As as mentioned in Chapter-III of Technical Conditions of Contract (Volume-IA Part-I in Book-I)
2.2.1.3.	Tag	
	Material	Aluminium / Fibre / Stainless Steel
	Markings	Engraving / Embossing / Printing
	Size	As required.
2.2.1.4.	Cable lugs	Copper / Aluminium (crimping type)
2.2.1.5.	**CLAMP SPACING:**	
	Other Clamps	
	A. Power Cables:	
	Above 35mm OD	
	i) Horizontal runs	Individually clamped at 3000 mm Interval (max)
	ii) Vertical runs	Individually clamped 3000mm intervals (max).
	Upto 35 mm OD	
	i) Horizontal runs	Collectively clamped at 3000 mm intervals (max)
	ii) Vertical runs	Collectively clamped at 2000 mm interval (max)
	B. Control Cables:	
	i) Horizontal runs	Collectively clamped at 3000 mm interval (max)
	ii) Vertical runs	Collectively clamped at 3000 mm interval (max)

	C. Spacing for cables supported along structure / ceiling	
	i) In horizontal runs	750mm (max)
	ii) In vertical runs	750mm (max)
	iii) Spacing between cables	30 mm (min)
	Note: a. Supports shall also be provided at each bend. b. For any change in above spacing, prior approval of Engineer shall be taken.	
2.2.1.6.	**Cable termination:**	
	Type of Lugs:	
	a. Power Cables	Copper / Aluminium / Both crimping type
	b. Control Cables	Copper pin type, copper screw type, Direct termination
	c. Special Cables	Pin type, maxi-termi type.
2.2.1.7.	**Wastage Allowances**	
	LT cables	1%
	Control, Instrument & Special cables	2%
	Fire Survival cables	1%
	Structural Steel materials	2% (by weight)
	Impulse Pipe/tubes/GI pipes/copper tube	1%
	Cable trays and earth Flats	2%

VOLUME-IA PART- II CHAPTER -3

GENERAL TECHNICAL REQUIREMENTS AND GUIDE LINES FOR INSTALLATION, TESTING & COMMISSIONING

2.3.1. **Guidelines for Installation of C & I Equipments**

2.3.1.1. Instruments location shall be decided to the convenience of operation and maintenance. The location shall have least mechanical vibration and placed where corrosive, toxic and explosive gases and dust particles will not deposit and the place is not subject to high-temperature atmosphere or radiation. However, actual location shall be decided in consultation with customer / consultant.

2.3.1.2. Maintenance platforms & approach facilities shall be provided for all sensing & primary devices wherever possible. Instruments shall be located in weatherproof enclosures and wherever required suitable canopy shall be provided.

2.3.1.3. High & Low pressure impulse lines shall not be grouped and run together. Also impulse lines for explosive & inert gases shall not run together.

2.3.1.4. Impulse lines of high pressure steam, harmful gases, etc. shall not be brought into the control room, as far as possible.

2.3.1.5. Intrinsically safe circuits shall be used for explosion hazardous areas.

2.3.1.6. Separate cable routing shall be followed for high and low voltage lines.

2.3.1.7. All electrical equipments shall meet the requirements of Indian Electricity Rules.

2.3.1.8. Wherever severe vibrations are expected, shock absorbers shall be provided

2.3.1.9. Installation of instruments with radioactive isotopes, mercury and other toxic substances shall be as per statutory regulations provided by authorities.

2.3.1.10. Compensating cables should be connected directly to instruments, i.e. no junction boxes shall be used if CJCBs are not provided.

2.3.1.11. Orifice plates or flow nozzles must be provided with at least 10D upstream and 5D downstream straight length of pipe from bends tees, branch pipes & control valves.

2.3.1.12. Pressure gauges shall be provided with snubbers, syphons (for more than 100°C), three way valve manifolds wherever applicable.

2.3.1.13. For pneumatic instruments, air shall be dry & free from oil. Air must be supplied from oil-free compressors specially erected for this purpose. After drying, air must be restored in receiver. Pressure gauges must be provided on each supply line and after the pressure reducer.

2.3.1.14. Correct level (height) between detecting element and tapping point and transmitter shall be maintained.

2.3.1.15. The equipment shall maintain its normal posture (level, perpendicular, front and back).

2.3.1.16. Connection between detecting element/tapping point and transmitter shall be maintained at short distances wherever practicable to avoid any time lag.

2.3.1.17. Orifice plates and control valves shall be mounted on process piping, only after completion of cleaning of the process piping in order that these instruments may not suffer damage from metal waste, etc.

2.3.1.18. For details of installing each measuring instruments, instruction manual issued by the respective manufacturer of instruments may be referred to, wherever necessary.

2.3.1.19. The drain pipes shall be terminated in a common closed header and finally the common header shall be connected to plant open drain.

2.3.1.20. Impulse pipe material shall be identified for each individual pipe prior to its use at site. For this purpose, coloring is to be done immediately after receipt.

2.3.2. **Guide Line for Erection of Impulse Lines**

2.3.2.1. All impulse lines burrs and airlines shall be thoroughly cleaned of any foreign matter by cleaning with compressed air and the same shall be done before installation.

2.3.2.2. The routing of pipelines shall include sufficient flexibility near tappings to allow for thermal expansion of the process equipment.

2.3.2.3. The pipes shall be cold bent using hydraulic bending machines only.

2.3.2.4. The horizontal impulse lines shall be laid with proper slopes towards the tapping point.

2.3.2.5. Supports for piping and tubing shall be adequate and in no case exceed limits shown below:

a) ¼" OD / ⅜" OD Copper - Continuous

b) ½" NB Pipe / Tube - 5'

c) ¾" NB Pipe / Tube - 5'

d) 1" NB Pipe / Tube - 8'

2.3.2.6. All impulse line welding shall be done through welding generator/rectifier and only structural welding could be done through welding transformer.

2.3.2.7. Impulse pipe of Alloy Steel / Stainless Steel / Carbon Steel shall be TIG welded wherever required. Welding of impulse pipe shall be carried out in accordance with BHEL welding procedure. The welding electrodes shall be approved by BHEL welding Engineers. Impulse pipes welders shall undergo welding Test and approved by BHEL welding engineer at site.

2.3.2.8. Minimum number of fittings shall be used on all lines wherever possible, to keep threaded joints to a minimum wherever thread connections are to be made.

2.3.2.9. The impulse pipe laying is recommended to be limited to a maximum of 10 metres (each limb) generally, unless otherwise specified, to have optimum response from the transmitter. However, this will depend upon plant layout.

2.3.2.10. Where the tapping point is subjected to mechanical shift due to heating / cooling of main equipment, care should be taken to route the impulse pipe in such a way as to absorb the shift of tapping point without straining the impulse piping. To accommodate this, sufficient loop for the impulse pipes can be provided near to the tapping point.

2.3.2.11. Alternatively, hose assembly - S.S. flexible may be used for connection between tapping point and impulse pipe.

2.3.2.12. The expansion bends are to be avoided as far as possible, as these act as air/sedimentation traps hampering the system performance.

2.3.2.13. Impulse piping shall be arranged as short as possible with a minimum of bends.

2.3.2.14. Horizontal piping shall be avoided and 1/10 slope shall be maintained.

2.3.2.15. Pipes shall not be laid parallel to high temperature process piping.

2.3.2.16. Pipe joints shall be carried out using sockets and flanges. Union fittings may be used when pressure is low. In the case of D.P. instruments both piping on low side and high side shall be maintained at same length and in the same route.

2.3.3. **Impulse Piping for Air & Flue Gas System**

2.3.3.1. For furnace pressure and furnace flue gas, suitable piping for air and furnace flue gas pressure, the impulse pipe shall be arranged to rise vertically from the tapping point to a distance at least of 300 mm before a change of direction is made.

2.3.3.2. Arrangements should be made for air purge in the impulse piping system at the end of the instrument airline or roding facilities may also be provided with suitable tees and cross.

2.3.3.3. In order to take care of the boiler expansion, suitable flexible connecting pipes can be arranged either at the tapping point end or at the instrument end.

2.3.4. **Impulse Piping for Vacuum Measurement**

The measuring instruments used on vacuum measurement should always be installed above the level of the tapping point in order to minimize measuring errors as much as possible. A suitable condensing chamber can be arranged which will eliminate the condensate or any blocking in the impulse pipe.

2.3.5. **Impulse Piping for Steam and Water System**

2.3.5.1. As a rule, instrument installation position for steam and water shall be downward from root valves.

2.3.5.2. Impulse pipes shall have a minimum slope of 1:10 and shall be supported at every 2 metres length.

2.3.5.3. At the transmitter end, the connection can be either through 2-way valve manifold or nipple with coupling.

2.3.5.4. In case 2-way manifold used and connected with nipple and coupling, it is necessary to provide tee with plug for purging or venting. The impulse pipe connection to the transmitter from the main pipe may be either upper side or lower side of the transmitter. In any case sufficient slope shall be maintained.

2.3.5.5. Some supplier recommends capillary type tube for transmitter connection from the impulse pipe to instrument by using S.S. tube and compression fittings.

2.3.5.6. It is always preferable to mount the instrument below the tapping points because the condensate shall protect the instruments against high temperature. In any case, the temperature entering the instrument should not exceed 150 F. In case the instrument is installed above tapping, before opening the process root valves, the impulse pipe shall be filled with water.

2.3.5.7. In the case of high temperature steam applications, sufficient length or siphon shall be provided to ensure certain length of condensate is formed thereby protecting breaking the measuring instruments from high temperature. Snubbers can also be provided if there is likely to be any pulsating of the medium measured.

2.3.6. **Bending**

2.3.6.1. It is recommended for cold bend for the impulse pipes with the help of a hydraulic bending machine to achieve a particular shape.

2.3.6.2. Use of 45° elbow and 90° bends (ready-made) is restricted to bare minimum to minimize the number of joints in a system. Hot bending is not to be used as this leads to flattening of pipes at the bends and also results in thinning of walls, apart from introducing changes in metallurgical properties of the pipe material.

2.3.6.3. Hot bending may be permitted for carbon steel pipe for low pressure service as instructed by supervisor only when it cannot be avoided. In the case of 90° bending radius shall be more than 3 times the outside diameter of pipe and in the case of 'u' bending, radius of bending shall be 5 times the outside diameter of pipe. When the radius of bending becomes small, elbow fitting shall be used.

2.3.6.4. Large bending shall be so made as to form smooth curve.

2.3.7. **Cutting**

- Pipe cutter or wheel grinder shall be used for pipe cutting.
- Gas cutting shall be avoided.
- Burr inside the cut end shall be removed.
- The cutting surface shall be as perpendicular to the axis as possible.

2.3.8. **Impulse Pipe Welding**

Generally, welding of impulse pipe and fitting shall be carried out by arc welding and socket welding is adopted. Welding shall be performed by a qualified welder only.

D.C. arc welding is recommended for impulse pipe. Motor generator is preferred to rectifier transformer, since it may damage the welding joints due to surge.

In order to prevent the cracking of the weld it is recommended to provide a small gap between the bottom of the socket and pipe end.

2.3.9. **Testing**

On completion of pipeline, installation, the pipelines shall be hydraulic tested. Contractor shall arrange for hydraulic pump and standard gauges and conduct the test satisfactorily.

The impulse lines shall be isolated from the instruments and tested at two times the maximum working pressures/ as specified by the customer. The fall in pressure shall not be more than 1 kg/cm2 or 1% of the working pressure whichever is less, in 30 minutes and there shall be no leaks, at any of joints / welds, when isolated from source of press.

2.3.10. **Guidelines for Installation of Pneumatic Line**

2.3.10.1. Copper tubing shall be connected with Olive type of compression fittings,

2.3.10.2. When two or more lines run together, the joint in the adjacent alternate line shall be a offset.

2.3.10.3. In case of copper tubing, the single run copper tube may be supported with an angle. However, suitable trays shall be used for more than one tubing.

2.3.10.4. Copper tubing shall not to be bend less than 10 D where is the OD of the copper tube.

2.3.10.5. All air distribution, main and branch lines shall be galvanised internally as well as externally and the galvanized pipe, never, shall be braced or welded.

2.3.10.6. The joints shall be screwed with Teflon tapping wherever the pipes are to be removed frequently for cleaning and other purposes and suitable union fittings shall be used.

2.3.10.7. Care shall be taken while taking a branch pipe to see that the line is not taken from the lower part of the main line or main header in order to avoid entry of any drain or dust into the system.

2.3.10.8. Instrument airline should not be routed where severe vibration, high temperature exists and adequate space should be available for maintenance.

2.3.10.9. Care shall be taken when removing the PVC sheeting, while connecting the copper tube. The exposed portion after jointing shall not be excessive and also while removing PVC, the tube should not get damaged. Pipe cutters should not

be used for cutting the copper tube, instead the specific copper tube cutter shall be used. Similarly, for bending copper tubes, specific copper tube bender should be used and the radius of the bending shall be more than 2.5 times of the OD of the copper tube.

2.3.10.10. While using the pipe cutter, care shall be taken to remove burr from the cutting side.

2.3.10.11. In locations where the copper tube is likely to be damaged from outside, the copper tube can be routed near a different pipe. While laying copper tube either inside angle or trays, the tube shall be supported at least at every one metre distance.

2.3.10.12. While fixing the copper tube fittings only Teflon tapes should be used. However, no tape shall be used while tightening the ferrules.

2.3.11. **Instrument Airline Testing**

- All instrument air lines shall be isolated from the instruments and pressurized pneumatically to maximum working pressure. It shall then be isolated from the source of pressure and fall shall be less than 1 psi in 20 minutes.
- All pneumatic signal lines shall be disconnected and blown through with instrument air. The line shall be blanked off and pressurized pneumatically 20 psi, and checked with soap solution for leak.

2.3.12. **General Guidelines on Installation of Flexible Hoses**

2.3.12.1. Flexible hoses can be classified into two broad categories, viz., Rubber hoses and Metallic hoses. The selection of the hoses is made depending upon the service conditions (pressure, temperature and other environmental conditions).

2.3.12.2. Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shrinkage or expansion. (However, excessive slack in hose lines is one of the most common causes of poor appearance).

2.3.12.3. At bends, provide enough hose for a wide radius curve. Too tight a bend pinches the hose and restricts the flow. The line could even kink and close entirely. In many cases, use of the right fittings or adapters can eliminate bends or kinks.

2.3.12.4. In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible and proper installation protects metal parts from undue stress, and avoids kinks in the hose.

2.3.12.5. Hose assemblies in service should be inspected frequently for leakage, kinking, corrosion, abrasion or any other signs of wear or damage. Hose assemblies that are worn or damaged should be removed from service and replaced immediately.

2.3.12.6. The service life expectation of a flexible hose mainly depend on the correct installation layout. In most cases, when flexible hoses fail prematurely, the reason of failure may be found in an incorrect layout.

2.3.12.7. As a rule, the hose is not to be bent over its limit of elasticity. The choice of the right hose length is of crucial importance. The hose should not be subject to torsion. Torsion can be usually eliminated by changing the layout.

2.3.13. **General Notes on Installation of Local Instrument Racks and JB Frames**

2.3.13.1. In cases where the local instrument stands are to be installed on a concrete foundation, it shall be fixed by anchor bolts.

2.3.13.2. In cases where the local instrument stands are to be installed on the base plate, the stand can be placed on an angle and the same can be welded. However, in cases where there is a probability for removal of stand is likely to arise, it shall be fixed by bolts.

2.3.13.3. Installation of local junction boxes shall be installed in such a way that they are fixed on a column by welding or by fixing bolts.

2.3.13.4. Local Instrumentation rack, which shall be installed utilising the Beam and Structure, shall be fixed by welding. Care shall be taken while deciding the location in order to ensure that no hindrance is caused to the maintenance personnel in their moving space within the work area. Further, as a standard practice, it should be ensured that no instrument stands/racks/JBs shall be supported by/welded on to any of the working equipment, or even hand grilled or floor grilled, as per safety norms.

2.3.13.5. Proper care should be taken to ensure that welding of the stand on any structure or Beam is fully welded.

2.3.14. **General Guideline on Flow Instruments Installation**

2.3.14.1. Extreme care shall be taken when welding and assembling the flow element on the pipe. Any misalignment or rough particle or edge inside the welded area may cause inaccuracy and this will increase as the flow increases.

2.3.14.2. Flow elements should always be located in upstream from any valve. Downstream side of valve shall no longer be a homogenous mixture and this may cause erratic behaviour of reading periodically.

2.3.14.3. Care shall be taken while welding the impulse pipe. Improper arrangement of piping of DP instruments can create error in the reading and even it gives an indication of negative flow of steam even though the flow is to be positive. Inadequate exchange of steam and condensate in the piping may cause negative flow. The presence of burr or dirt in the pipe can impede the flow of condensate back to the pipe, and when this happens, the pipe becomes full of water and has the effect of creating negative head.

2.3.14.4. Always ¾" to 1" pipe is recommended for free flow condensate. Gate valve shall be used for the tapping and pipe should be insulated up to condensing pot.

2.3.14.5. The Measuring instrument shall be located close to the flow-sensing element. The speed of response is reduced if there is a long run.

2.3.14.6. The orifice plates shall be installed such that the extreme face is perpendicular to the axis of the pipe within the +2 deg or -2deg. and it should be ensured that when the extreme face is facing the direction of flow, invariably the sign of positive (+) is marked on the upstream.

2.3.14.7. Location of Flow element should have clear straight run of 10D in upstream and 5D in downstream.

2.3.14.8. For non-viscous liquid flow measurements, the best location for the instruments shall be below the pipeline, If the instrument is above the line, more maintenance will be involved. Suitable vapour traps shall be provided.

2.3.14.9. In the case of air and gas flow measurement system, as part of basic requirement, it should be transmitted to the instruments without any change in the differential head due to leakage.

2.3.14.10. If the flow of any dry gases are to be measured, the location of instrument can be kept above or below the tapping points.

2.3.14.11. For air flow measurements, it is always preferable to install the instruments above the pipeline. In case, if the instrument must be installed below the duct/pipeline, suitable Dust Collection Chamber can be installed.

2.3.14.12. The condenser pot should be located nearer to the tapping point and both condenser chamber should be at the level of upper tapping,

2.3.14.13. The unequal level will cause significant error due to false heads. If the flow nozzle is installed in vertical pipe, the lower tapping pipe which is bent and taken up to upper tapping in order to align with the upper condensate pot, must be insulated, otherwise, error is created when the bent pipe fills with condensate. The error may add or subtract depending upon the direction of flow.

2.3.14.14. For flow measurements, the instruments should always be located below the condenser pot, otherwise, the condensate will be lost from the system and the instrument will reach 'O' during the shutdown and the total system must be vented after the startup of the boiler in order to remove Air and Vapour which might have got entrapped.

2.3.14.15. In an installation where the instruments must be located above the tapping points and the condensing chamber should be equally located above the instruments the pipeline up to the condensing pot should be insulated.

2.3.14.16. In the case of viscous fluids, flow measurements which are likely to freeze or concealed in the pressure pipe or like such corrosive type fluids, suitable sealing chamber shall be used, the sealing liquid should not mix or react with the medium to be measured.

2.3.14.17. The commonly used sealing liquid includes water, light oil, glycerol, ethylene glycol and mixtures of the last two with water.

2.3.14.18. The sealing chambers, in each pressure pipe, should be installed at the same

level and as close as possible to the pressure tappings.

2.3.14.19. The general arrangement for pressure tappings from the Sealing Chamber to the instrument is shown in the sketch.

2.3.14.20. The flow elements should be inspected before installation to find out the presence of any corrosion/rusting or any blockage on the pressure tapping holes or any deposits on the face of the orifice plate.

2.3.15. **General Guideline on Installation of Valves**

2.3.15.1. Primary isolating valves (root valves) must be located at the tapping which can be of globe valves.

2.3.15.2. These valves shall be installed where access is possible.

2.3.15.3. Secondary isolating valves shall be located at the end of inter-connecting pipe. It should be as nearer as possible to the measuring instruments and should be of needle type.

2.3.15.4. For pressure more than exceeding 40 kg, 2 isolating valves shall be provided.

2.3.15.5. In the case of heavy duty isolating valves, suitable support shall be provided to avoid any loading on the stubs.

2.3.15.6. In viscous fluids, suitable steam tracing shall be provided.

2.3.15.7. These valves are always located as nearer to the measuring device as possible.

2.3.16. **Blowdown Valves or Drain Valves**

a. These valves are fixed at the lowest end of impulse pipe.
b. In the case of high-pressure line always 2 valves shall be fitted in series. Normally, these valves will be of globe type.
c. For low-pressure application, single valve is used.
d. In case of air and flue gas measurements, either a plug or a suitable gate valve of gunmetal `on/off' valve shall be provided.
e. The drain valve shall be connected to the common drain header which finally is terminated at plate operation drain system.

2.3.17. **PAINTING**

All the supporting steelworks impulse pipe shall have protective painting. The surface shall be free from rust, foreign adhering matters, grease etc. Two coats of rust preventing red-oxide primer and final painting of two coats as per the colour DECIDED by the site engineer. After cleaning the surface is painted with one coat of Red oxide zinc chromate primer confirming to IS 2074 and allowed to dry completely. The primer- coated surface is painted with two coats of final painting of desired colour which shall be selected from IS-5.

2.3.18. **GUIDELINES FOR CABLE LAYING**

2.3.18.1. In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.

2.3.18.2. In case of multicore cables of diameter upto 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.

2.3.18.3. Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.

2.3.18.4. GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.

2.3.18.5. In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy-duty PVC pipes shall be provided.

2.3.18.6. Entry of cables through trenches/tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.

2.3.18.7. Cables laid exposed in racks / trays and routed through trenches / tunnels / basements etc. to individual drive / control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment in the panels located, above trenches, tunnels or basement.

2.3.18.8. All cables routed along walls or in equipment rooms shall be protected by means of laying them through GI pipes or by providing sheet metal covers up to a height of 2000mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.

2.3.18.9. Tray covers shall not be provided for the cable trays within trenches, tunnels and basements. Non-perforated type sheet steel covers shall be provided for the trays in the areas susceptible to accumulation of coal dust/atmospheric abuses etc.

2.3.18.10. Cable trays shall be supported on ISA 50 X 50 X 6mm MS / GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas.

2.3.18.11. Wherever direct heat radiation exists, heat isolating barriers (subject to customer's approval), for cabling system shall be adopted.

2.3.18.12. For 415V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded / exposed GI conduits or rigid PVC pipes as applicable.

2.3.18.13. If required, a few number of cables in exceptional areas may be directly buried

into the earth.

2.3.18.14. Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth as decided by Engineers.

2.3.18.15. At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.

2.3.18.16. In corrosive atmosphere, PVC conduits shall be used for cables.

2.3.18.17. Single core cables, when pulled individually shall be taken through PVC pipes only.

2.3.18.18. Laying and installation of power, control and special cables shall generally conform to IS: 1255

2.3.18.19. The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).

2.3.18.20. In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks / trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.

2.3.18.21. Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.

2.3.18.22. Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255.

2.3.18.23. All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor / wall crossings, every 20m/25m spacing for straight runs or as specified by Engineer for easy identification of cable.

2.3.18.24. When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.

2.3.18.25. Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.

2.3.18.26. Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacings not less than one cable diameter of bigger diameter cable.

2.3.18.27. All 1100 V grade multicore power cables and single core DC cables shall be

placed in single layer, touching each other and clamped by means of single or multiple galvanised MS saddles / aluminium strips / nylon cable ties. Cables above 35mm diameter shall be clamped individually.

2.3.18.28. Control cables shall be laid touching each other and wherever required may be taken in two layers. All control cables shall be clamped with a common clamp / tie.

2.3.18.29. Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:

a. HT cables shall be laid in the top tier(s)

b. LT power cables to be laid in the tray(s) below the HT cable trays.

c. LT control cables to be laid in the Tray(s) next below to the LT power cable tray(s)

d. Special control cables including screened control cables to be laid in the bottom most tray(s).

2.3.18.30. For vertical formations, the trays closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed. However, where there is no clear distinction of bottom / top trays, the order convenient for linking the horizontal and vertical formations shall be followed.

2.3.18.31. When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses indicated above, the following rules shall override the criteria. However, prior approval of the Engineer will be required.

In hierarchical order:

a. Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.

b. LT power cables are mixed up with control cable with clear minimum gap of 150mm between them.

c. LT power cables are mixed up with HT power cables with clear minimum gap of 200mm between them.

d. LT power cables are mixed up with special control cables with clear minimum gap of 200mm between them.

2.3.18.32. In case of duplicate feeders to essential loads, the respective cables shall be laid through separate raceways. Alternatively, such cables shall be laid on the opposite sides of a trench/tunnel/basement.

2.3.18.33. For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanised.

2.3.18.34. For laying cables along concrete walls, ceilings etc. The cables shall be taken by

clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 6mm thickness.

2.3.18.35. To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoap or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.

2.3.18.36. No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits / pipes in trefoil formation only.

2.3.18.37. In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.

2.3.18.38. Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.

2.3.18.39. Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.

2.3.19. **Support Spacings & Clampings**

Support spacing and clamping suitably provided and as required.

2.3.20. **Laying of cables directly buried in ground**

Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.

2.3.21. **Codes and Standards**

Installation of cabling work shall comply with the following Indian Standards (Latest editions):

IS 1255	Code of practice for installation and maintenance of power cables upto and including 33 kV rating.
IS 732	Electrical wiring installation (system voltage not exceeding 650 V).
IS 5216	Guide for safety procedures and practices in electrical works.
IS 226	Structural steel (Standard quality).
IS 800	Code of practice for use of structural steel.
IS 316	Code of practice for use of metal arc welding for general construction in mild steel.
IS 1363	Hexagonal bolts, nuts and screws

IS 1572 Electroplated coatings of cadmium on iron and steel.

IS 2629 Code of practice for hot dip galvanising for iron and steel.

IS 2633 Method of testing uniformity of coating on zinc coated articles.

IS 15908 Selection, Installation and Maintenance of Control and Indicating equipments for Fire Detection and Alarm System- Code of Practice

IS 2189 Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System-Code of Practice

In addition to the standards mentioned above, all works shall conform to the requirements of the following rules and regulations.

a. Indian Electricity Act and Rules framed there under
b. Fire insurance regulations
c. Regulations laid down by the Chief Electrical Inspector of State
d. Regulations laid down by the Factory Inspector of State
e. Any other regulations laid down by the authorities.

In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.

2.3.22. **Guidelines For Erection of Cable Trays, GI Pipes, Supports and Accessories**

2.3.22.1. Constructional details and supporting arrangement for the cable trays shall be as shown in the drawings which will be handed over to the successful bidder. All cable trays, vertical raceways and supporting steel work shall be installed along the routes as indicated in the drawings and as per the instructions of the Engineer-in-charge. The contractor has to fabricate and install complete tray supporting structures as per the drawing / site requirement.

2.3.22.2. Wherever specified or directed by Engineer, the contractor shall install galvanised MS sheets covers over cable trays. The width of the covers shall be same as that of cable trays. Bolting shall be done to fasten covers to the cable trays, elbows, reducers, tees, crosses etc.

2.3.22.3. The contractor shall install all angles, channels, beams, hangers, brackets, clamps etc. as may be necessary to suit the actual site conditions to support the cable trays.

2.3.22.4. Straight pieces of standard MS angles / channels shall be used for fabrication of supports / racks. All welded joints shall be smooth enough to provide a good appearance and shall not cause injury to working personnel.

2.3.22.5. Cable trays within cable trenches, tunnels and basements shall be of ladder type. Bottom most tray within plant buildings for overhead runs of trays shall be of perforated type. Cable trays in the areas exposed to coal dust shall be installed in vertical formation. Wherever due to layout constraints, it is not possible to install

the trays in vertical formation with Engineer's prior permission installing the trays in horizontal formation may be considered.

2.3.22.6. Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way or maintenance of adjacent equipment.

2.3.22.7. For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.

2.3.22.8. For equipment and devices having GI conduit entry arrangement other than standard GI conduit adopter, adopters shall be provided as required to enable the GI conduit to be properly terminated, between conduit end and motor T.B.

2.3.22.9. GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.

2.3.22.10. The entire G.I. conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the Gi pipes entering them.

2.3.22.11. Bends of G.I. pipes / conduits shall be made without causing damage to the pipes / conduits.

2.3.22.12. Occupancy of conduits shall not be greater than 40%.

2.3.22.13. The adopter for coupling rigid GI pipe / conduits and flexible conduit shall be of aluminum or galvanized steel.

2.3.22.14. Transportation and storage of cable drums

2.3.22.15. Transportation and storage of cable drums shall generally conform to the requirements of IS: 1255

2.3.22.16. All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.

2.3.22.17. The cable drums shall be transported on wheels to the place of work.

2.3.23. **Guidelines for Cable Termination and Jointing**

2.3.23.1. Contractor shall carry out cable terminations at various electrical and electronic equipment terminals.

2.3.23.2. When the equipment are provided with undrilled gland plates for cable / conduit entry into the equipment, drilling and cutting on the gland plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before driling holes. Cutting shall not be allowed.

2.3.23.3. Termination of cables shall be done as per termination drawings & interconnection diagrams furnished to the contractor. Looping of cores / wires at terminals as shown in interconnection diagrams is to be done by the column at no extra cost as part of the termination.

2.3.23.4. All cable entries in the equipment shall be sealed after glanding the cables.

2.3.23.5. Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core / conductor.

2.3.23.6. Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals.

2.3.23.7. Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes / nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.

2.3.23.8. Screened control cables of 0.5 sq.mm cross-sectional area shall be terminated by means of wire rapping system.

2.3.23.9. Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per the control schemes and other related documents supplied.

2.3.23.10. End sealing / termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.

2.3.23.11. Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs.

2.3.23.12. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.

2.3.23.13. Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.

2.3.23.14. Junction boxes shall be used, wherever required, for jointing of control cables.

2.3.23.15. Termination and jointing shall generally conform to the requirements of IS: 1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.

2.3.24. **Design Requirements of Items supplied for cabling installation work (if supply is covered in contractor scope).**

2.3.24.1. **Strip Cable Clamps**

a. Strip Clamps shall be of aluminium alloy or cast steel or M.S. and shall be used to fasten the group of multicore cables on the tray.

b. Clamps shall be of simple construction, made of 4 mm thick, 25 mm wide strip to cover the entire width up to 300 wide tray and part of the tray for more than 300 wide trays. Strip shall have two right angle bends for fixing on the rung with two bolts.

c. Clamps shall be of different lengths for different sizes of tray width. The maximum size of clamp width shall be 300 mm and for cable trays of greater width, two clamps shall be used.

2.3.24.2. **Self Locking Clamps**

a. Clamps shall be of nylon material / fibre glass.

b. Clamps shall have self-locking feature when the cord is looped.

c. Clamps shall be provided with manual lock release.

d. Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.

e. Type test certificates to ascertain the strength of clamps shall be submitted for purchaser's approval.

f. Nylon self-locking clamps shall be of BHEL approved make only.

2.3.24.3. **Ferrules**

a. Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter.

b. Ferrules shall be of plastic material.

c. Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave coloring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600 mm.

d. Ferrules shall be interlocking type in such a way that the interlocked ferrules take the shape of tube with complete ferrule number appearing in a straight line.

2.3.24.4. **Tags**

a. Cables shall be provided with cable number tags for identification.

b. Cable tags shall be of durable fiber, aluminum, stainless steel sheets or lead of suitable thickness

c. Cable number shall be engraved type in case of aluminum or stainless steel tags, and printed type in case of fiber sheet.

d. Tags shall be durable quality of size 60mm x 12mm with holes at both ends.

e. Samples of tags shall be approved by BHEL Engineer before delivery.

f. Tags shall be provided with non-corrosive wire of sufficient strength for

tagging's.

2.3.25. **GUIDELINES FOR EARTHING INSTALLATION**

2.3.25.1. All equipment shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.

2.3.25.2. The earthing conductors shall be mild steel / G.I. strips / wires. All connections from the equipment to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the successful tenderer.

2.3.25.3. A continuous earthing conductor shall be installed in all cables trays and securely clamped to each tray section by suitable connectors to form a continuous earthing system. When two or more trays supporting power cables run on parallel a continuous earthing conductors shall be provided on one tray only with tap offs to the control cable trays. All valve and damper motor and rapping motors will be earthed to this conductor.

2.3.25.4. All joints in the earthing system shall be welded type. Earthing connections to all equipment including motors shall be bolted type.

2.3.25.5. Earthing connections shall be free from tinning scale, paint, grease, rust or dirt at the time of making joint.

2.3.25.6. Metallic sheaths, screens / shields and armor of all multicore cables shall be bonded and earthed.

2.3.25.7. Earthing conductors along with their run on columns, beams, walls etc., shall be supported by suitable cleats at intervals of 750 mm.

2.3.25.8. Conduits shall be bonded together and grounded at all switchgear and control centers.

2.3.25.9. M.S.Earthing conductors shall be coated with one coat of bituminous paint, wrapped with a layer of bitumen tape and finally coated with bitumen paint. For site welded GI strips / wires required coat of aluminium paint should be given.

2.3.25.10. If the equipment is not available at the time of earthing conductor laying tap connections from the main earthing conductor shall be brought out up to slab equipment foundation level with at least 200 mm spare length left for further connections to equipment earthing terminals.

2.3.26. **Guidelines for Erection of Control Panels and Distribution Boards**

2.3.26.1. The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base channels will have to the grouted. Suitable concrete drilling machine shall be used for making hole on the concrete floor.

2.3.26.2. For the panels which are to be mounted on the trenches, channel supports have

to be provided across the cable trenches over which the base frames of the panels shall be mounted. Fabrication and installation of these support structures shall be carried out as per drawings.

2.3.26.3. All the panels / board shall be placed on its foundation or supporting structures and shall be assembled equipment as required. All equipment should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.

2.3.26.4. All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.

2.3.27. **The following points shall be checked up during erection**

a. Layout of foundation channels.

b. Floor level covered by the panel with respect to main floor level.

c. Location and serial no. panels.

d. Positioning of panels.

e. Verticality of panels and breaker truck to station earth.

f. Earthing of panels and breaker truck to station earth.

g. Lugs for termination of HT and LT cables.

h. Mounting and fixing arrangements all modules.

i. Check the operation of:
   (i) Remote control
   (ii) Various required - closing / tripping / alarm / indications / interlocks Installation position of instruments and relays Operation of relays and instruments.

j. AC / DC supplies for panel.

k. Tightness of terminal connections for HT & LT connections.

l. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

2.3.28. **415 V switchgear and Electrical panels tests (as applicable)**

a. IR Test on each pole of breaker

b. IR test on control circuit

c. Measurement of contact resistance for all three phases of breaker

d. Measurement of resistance of the closing and tripping coil of breaker

e. Checking the close trip operation at 70% and 100% of the rated auxiliary D.C. Voltage.

f. Checking of interlocks provided and tripping of breaker through relays

g. Space heater operation check
h. Opening and closing time check
i. Control and metering circuit checks.
j. Primary and secondary injection tests.
k. Thermal overload relay testing and checking
l. Calibration of all instruments and meters
m. Phase rotation checks
n. High voltage test on 7C.1.3 kV switchboard

2.3.29. **Cutting & Wastage Allowance**

The following scrap allowances are permissible:

	Description	Non-salvageable	unaccountable
1.	Length below 0.5 m steel pipes, Stainless / Copper tubes, Single pair cables	2%	0.5%
2.	Length below 20m multi cable, multitubes	2%	0.5%

2.3.30. **Guidelines for handling of solid state modules:**

- All the solid-state modules shall be handled by qualified person.
- Electronic modules should only be touched when it is absolutely essential.
- Before touching any electronic modules, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strip.
- The operator should not wear clothing made entirely from synthetic fibres, but a mixture containing atleast 65% cotton.
- PCB should always be held by the front panel or by the module frame and the electronic components should never be touched.
- The electronic modules should never be placed close to television sets or CRT units.
- Soldering irons and any other tools used must be grounded.
- All modules using CMOs components are packed in antistatic bags, when transported loose to avoid ESD failures. The antistatic bags must always be used to transport modules at site from one place to the other.

2.3.31. **Guidelines for landing and storage of Electronic Cubicles / sub-assemblies / loose items.**

2.3.31.1. Immediately after unloading at site, the electronic equipment should be kept in the covered area. Handling and lifting of the package should be done without jerks or impacts. Packing case should not be dripped or slid along the floor under any

circumstances. Suitable forklift should be used to move the case to its final position. All the above points are to be strictly followed as the electronic equipments cannot withstand any stress due to vibration and shock.

2.3.31.2. After unloading at site, the package of the equipment shall be inspected for external damage. In case the package is damaged, the package number and details of the damage should be noted. The details of the damage should be reported to the responsible site Engineer.

2.3.31.3. Cases should be opened / unpacked using correct nail pullers. While opening the planks, care should be taken to see that the equipment is not damaged. Cases should not be unpacked in areas where they are exposed to rain water / liquid splashing, dust or other harmful materials like chlorine gas, sulphur dioxide etc.

2.3.31.4. After opening the case, all supports provided for transport are to be removed with due care.

2.3.31.5. Hinged frames should not be opened when equipment is not secured to the floor as this is likely to cause it to topple over. The hinged frame can be opened only if the equipment is still fixed on to the bottom wooden pallet.

2.3.32. **Guidelines for installation of LHS/OLHS cables** The actual guidelines as recommended by OEM are to be followed. BHEL Site Engineer's decision will be final.

Annexure

C1

DATE:31/08/2021

T&P HIRE CHARGES

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	24500.00	24500.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	10940.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	53560.00
4	PORTAL CRANE, 360T	15	14070.00	13390.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	52770.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	68610.00	65280.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	31880.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	19920.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	28690.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	30130.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	25110.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	34580.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	14390.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18050.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	15940.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	20720.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10360.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	12750.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10420.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10200.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8440.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9560.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9560.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5210.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	5880.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5150.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4230.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	2910.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2180.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2180.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	680.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	370.00

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	650.00	640.00
31	FORK LIFT 3T	5	540.00	530.00

Annexure C2 DATE:31/08/202

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	27230.00	27230.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12160.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	59520.00
4	PORTAL CRANE, 360T	15	15630.00	14880.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	58630.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	72540.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	35420.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	22140.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	31880.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	33480.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	27900.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	38420.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	15990.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20060.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	17710.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	23020.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	11510.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14170.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11580.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11330.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9380.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	10620.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	10620.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5790.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6540.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5720.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4700.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3240.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2430.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2430.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	760.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	410.00

Annexure C2 DATE:31/08/202

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	720.00	710.00
31	FORK LIFT 3T	5	600.00	590.00

Annexure I

RATES FOR INTER REGIONAL HIRE CHARGES FOR CRANES OF CAPACITY 75 TON OR MORE FOR PERIOD 01-09-2021 TO 31-08-2023

Dt : 31/08/2021

SL NO.	ITEM DESCRIPTION	Rates (Rs./MONTH) valid from 01/09/2021 to 31/8/2023
I.	CRANES : –	
1	Portal Gantry Crane 500T	1243192
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	631183
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	2717358
4	PORTAL CRANE, 360T	679333
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	2676917
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	3311783
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	1617475
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	1010917
9	MANITOWOC M-250T TRUCK CRANE	1455725
10	270 MT Class Crawler Crane- Manitowoc Model 2250	1528508
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	1273758
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	1754150
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	730283
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	915892
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	808733
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	1051358
15	CRAWLER CRANE SUMITOMO, 150T	525675
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	646983
17	CRAWLER CRANE, 120 T Fushun Model QUY120	601125
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	517592
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	428625
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	485242
20	CRAWLER CRANE 100 T (KH 500)	485242
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	300558
22	ROUGH TERRAIN CRANE 75T (RT880)	321758
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	281533

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1160
22	Air Blower (Flow: 20000 m^3/Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB DIAGONISTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 µΩ TO 20KΩ	3230
59	PMI Machine OLYMPUS make	3350
60	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	430

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360
96	Plasma Cutting Machine (With complete accessories)	310
97	JCB make DG Set 80 KVA	670
98	Diesel Generating Set 82.5 KVA	610
99	Portable Jacking Oil Pump	1080
100	Alloy Analyser	1770

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	7070
3	-DO- , WITH STORAGE TANK	8080
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1510
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	2020
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1410
9	Low Vacuum de-hydration unit	700
10	DIESEL GENERATING SET,250 KVA	1970
11	DIESEL GENERATING SET,25 KVA	560
12	VACUUM PUMP(ABSOLUTE V.C.)	600
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1210
14	ACID TRANSFER PUMP 20/50 T/HR	600
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	90
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4710
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m³/Hr)	1290
22	Air Blower (Flow: 20000 m³/Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGONISTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 μΩ TO 20KΩ	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast - 9 metres (4X400 W)	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	510
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500

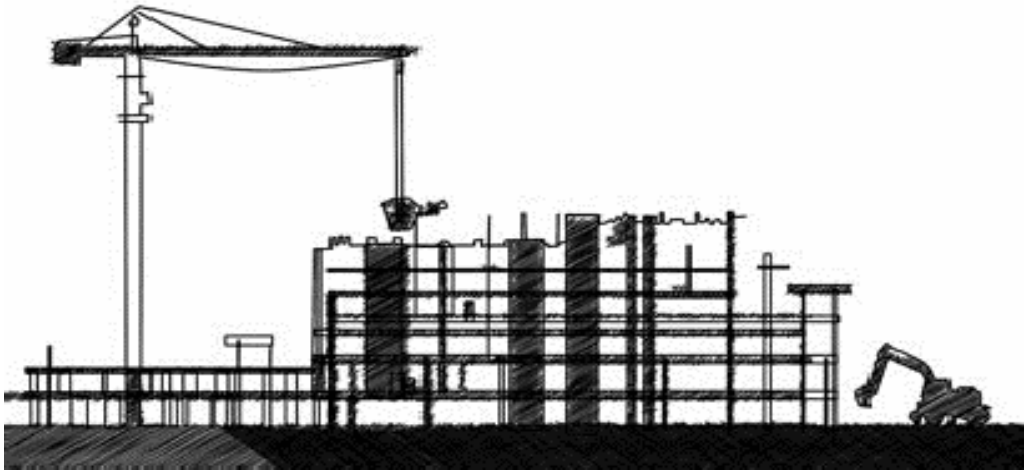
ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400
96	Plasma Cutting Machine (With complete accessories)	340
97	JCB make DG Set 80 KVA	740
98	Diesel Generating Set 82.5 KVA	680
99	Portable Jacking Oil Pump	1200
100	Alloy Analyser	1970

HSEP14

Health, Safety & Environment Plan for Site Operations by Subcontractors



Bharat Heavy Electricals Limited, Power Sector
Regd. Office: BHEL House, Siri Fort, New Delhi – 110049, www.bhel.com

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SECTION A

CRITICAL RESOURCES FOR HSE IMPLEMENTATION

1. SHARING OF OPERATING COSTS OF FACILITIES

TABLE A.1

SN	FACILITY
1	Ambulance with 24 hr. First Aid Trained Driver (Specs in Annexure A)
2	Operation of Medical center, Nurses, Medical Consumables etc. (Specs in Annexure A)
3	Training Center Consumables
4	Water sprinkling for dust suppression
	(Others:)

Note:

i. Responsibility of operation of above facilities shall rest with BHEL
ii. Operating cost of the above shall be deducted from subcontractors on 'proportional to contract' value basis. Sample deduction table enclosed as Annexure A.1
iii. "Contract value" defined above & subsequently in the document shall be considered as "Awarded contract value".
iv. No overhead cost/ enabling cost of BHEL shall be levied on the contractors for common facilities.
v. These running costs shall be recovered from all the available subcontractors at site for the complete operational duration of the site
vi. No overheads shall be charged on shared operating costs

2. RESOURCES TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

TABLE A.2

SN	ITEM	SPECIFICATIONS
1.	HSE DISPLAYS, Posters and signage	Annexure B
2.	HSE Tools/ Equipment/ Devices	Annexure C
3.	Rest Sheds for Workers	Annexure D
4.	Labor Colony	Annexure E
5.	Toilets (Latrines & Urinals) - in Site and Labor Colony	Annexure F
6.	Fire Extinguishers	Annexure G

Note:

In case subcontractor fails to provide the required resources, same will be procured and deployed by BHEL with applicable overhead on total procurement cost

3. ESTABLISHMENT OF COMMON FACILITIES

In green field projects BHEL shall arrange and provide the following facilities which shall be used by all subcontractors for their employees and workers. These shall be

i. Medical Centre
ii. Safety park with facilities of audio-visual training & vertigo test center.
iii. No cost shall be deducted from the subcontractors for the structure part only.
iv. The running cost with basic inputs already mentioned at Point 1 above shall be shared by all contractors.
v. The sub-contractors shall be required to ensure participation in trainings, medical checkup and vertigo test as per the guidelines laid in this document and required as per statutory HSE requirements.

vi. However, in projects where in these facilities are not provided by BHEL, subcontractors shall ensure the training, medical/ vertigo test of all workers at site in consultation and guidance of BHEL HSE team at site in line with provisions of this document.

vii. The overall onus of compliance to HSE practices pertaining to training, medical checkup including vertigo test shall lie on the subcontractor only.

4. CRITICAL REQUIREMENTS W.R.T. EQUIPMENT & PPES

i. Conventional Hydra crane with carriage in front shall not be permitted. Pick & carry tyre mounted Front Cabin mobile crane (FX or TRX/ NextGen series of 'ESCORT" or equivalent make) shall only be permitted.

ii. Any Heavy equipment (cranes, winch machines, etc.) shall be deployed only after pre-safety Inspection by safety dept. Valid AMCs/ Fitness/ other statutory clearances as per local rules shall be required to be submitted before mobilizing the equipment at site.

iii. All other Hand tools and power tools should not be older than 5 years.

iv. For Chimney passenger lift, winch to have double drum rope for passenger and double safety devices must be used. Winch should not more than 3 years old and winch rope must be inspected with valid certificate from competent authority within 6 months and should meet the IS standard 9507 provision of OLR and push back button arrangement or dead man switch.

v. Gate pass for all the lifting T&Ps and construction machinery/ equipment shall be made after obtaining written acceptance (Pre-entry Safety Clearance) from BHEL Site Safety Department after physical verification and checking all requisite documents/ compliance to Safety norms

vi. All motor vehicles should have valid registration certificate, insurance, Pollution under control (PUC) and fitness certificate as per Motor Vehicle Act 2020. The certificates should be pasted in the glass from inside.

vii. PPEs shall be from reputed manufactures viz. 3M, Udyogi, Karam, Frontier, Freedom, Honeywell, Liberty, Bata, Nomex, Acme, Unicare, Life Gear or equivalent. In case Subcontractor recommends any other name the same can be approved at site level by the Construction manager & Site HSE

viii. For height work, where fall could result in death or disability, a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) shall be mandatorily provided by the subcontractor, failing which, a penalty of INR 10000 per case will be imposed. In addition, there should be constant supervision for such critical height work. Any non-erection activities at height eg. Housekeeping etc. shall also fall under the category of height work

ix. **Scaffold Tagging**

Scaffolds being erected, modified or dismantled must be tagged as suitable for use. Tagging shall be done with standard tag holder. Scaffolding tag should be certified by scaffolding inspector having valid certificate.

- **GREEN** scaffold tag- shall be fixed when scaffold is complete and safe for use, signed and dated by the scaffolding competent person daily.
- **RED** scaffold tag – to be fixed if scaffold is in some way defective and cannot be used or is still under erection.
- **YELLOW** scaffold tag – to be fixed if scaffold is in under construction/ maintenance.

FIG. A.4.1 SAMPLE SCAFFOLD TAGS AND TAG HOLDER

x. **T&P Color Coding:**

a. Inspections and tests shall be documented by means of color coding which shall verify that inspections or testing are current and that all receptacles, portable Power tools, Lifting Tools & Tackles have been inspected and tested as required. The color codes used on the project shall be:

GREEN	BLUE	YELLOW	PURPLE
January	April	July	October
February	May	August	November
March	June	September	December

TABLE. A.4.2: T&P COLOR CODES

b. The cycle of colors shall be Quarterly as a minimum or as decided by BHEL. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.

c. Following the initial inspection, the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the subcontractor.

d. Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.

e. All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and discard immediately if they fail to meet the minimum requirements of the project.

f. The Subcontractor's HSE Officer shall ensure that all PPE is inspected prior to its issue. He is to ensure all subcontractor personnel are using safe and proper PPE equipment. Regular

inspections on the PPE shall be carried out and personnel not adhering to those inspections shall be removed immediately from the site.

g. A Ten (10) day interval period shall be given into each monthly color code change. During this Ten (10) day period either color shall be acceptable.

xi. **T&P Tagging:**

All deployed Wire Rope Slings, Chain Pulley Blocks, Hooks, slings etc. shall be Tagged using aluminum or any other metal tag with punching.

5. HSE PERSONNEL TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

5.1. NUMBERS OF HSE PERSONNEL (APPLICABLE FOR EACH WORK SHIFT)

Number of HSE Officers and Supervisors shall be in proportion to number of workers as per Table A.6 below

TABLE A.5

No. of Workers	No. of HSE Supervisors	No. of HSE Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5

5.1.1. DEPLOYMENT PLAN

i. Above requirement is for every shift for each unit.

ii. The dynamic deployment plan of Safety manpower at various locations containing names, areas, time periods, shifts etc. shall be submitted to BHEL for approval by subcontractor

iii. BHEL may modify the deployment plan based on nature and volume of jobs, Risks and hazards associated etc.

iv. For less than 20 workers HSE Officer is not mandatory. In case the number of workers exceed 20 for 3 consecutive months, HSE Officer is to be engaged. The HSE Officer shall be deployed for a minimum period of 6 months even if the number of workers fall below 20 in any month subsequent to deployment. If within that 6-month period, the number of workers is more than 20 for at least 3 months, the deployment duration of HSE Officer will extend further 6 months after completion of previous 6-month period.

v. For Site Material Management/ Handling (Loading/ Unloading) contracts, 1 no. HSE Officer shall be required irrespective of the total manpower deployed.

vi. HSE Officers/Supervisors of all the vendors may be required to report directly to BHEL HSE Officer at site & shall comprise as a total team for handling all HSE issues. However, each safety officer/ agency shall be individually responsible for the safe execution of work in their respective areas.

5.2. Qualification & Experience Requirements Of HSE Personnel

5.2.1. HSE Officer

First HSE Officer to be mandatorily as per Option I as under and shall be designated Senior HSE Officer. In case of non-availability of HSE Officers with Option I configuration, the subsequent HSE Officers can be as per Option II below with recorded reasons and approval of Site Construction Manager of BHEL. All these deviations should be reported to Region HSE and PSHQ HSE.

A. Option I

i. possesses a recognized degree in any branch of engineering or technology or architecture and had a practical experience of working in a building or other construction work in a supervisory capacity for a period of not less than two years or possesses a recognized diploma in any branch of engineering or technology and has had practical experience of building or other construction work in a supervisory capacity for a period of not less than five years;

ii. possesses a recognized degree or diploma in industrial safety with at least one paper in construction safety (as an elective subject/ part thereof);

iii. has adequate knowledge of the language spoken by majority of building workers from the construction site in which he is to be appointed.

B. Option II:

Graduation Degree in Science with Physics & Chemistry and degree or diploma in Industrial Safety (All Degrees/ Diploma from any Indian institutes recognized by AICTE or State Council of Technical Education of any Indian State) with practical experience of working in a building, plant or other construction works (as HSE Officer, in line with Indian Factories Act, 1958 or BOCW Act, 1996) for a period of not less than five years

Note:

i. HSE Officer as per Option II shall be valid only on availability of Senior HSE Officer as per Option I at site.

ii. In case of resignation of the Senior HSE Officer, the same has to be replaced within 15 days else all subsequent HSE Officers as per Option II (in case of multiple HSE Officers with a single agency) shall not be considered as valid.

iii. The penalty shall be deducted considering non-availability of any HSE Officer at site.

5.2.2. HSE Supervisor: Either of X or Y below

X. Recognized Degree in any branch of Engineering OR Diploma in any branch of engineering with at least one-year construction experience

OR

Y. A recognized graduation Degree in Science (with Physics & Chemistry) or a recognized diploma in Engg. or Tech.

Additional requirements for option (Y) above

i. Trained in fire-fighting as well as in safety / occupational health related subjects, with:
ii. Minimum Two years of practical experience in construction work environment or in the field of safety and

Note:

i. Option a above is by default, b is under special approval from Site HSE & Construction manager
ii. In both cases the candidate should possess requisite skills to deal with construction & fire safety related day-to-day issues.

5.3. HSE In-Charge

In case there is more than one HSE Officer with any subcontractor, one of them, who is senior most by experience & meets qualification as per option 1 as mentioned in clause 2.1 A above (in HSE discipline), may be designated as HSE In-charge who will be the nodal point of contact on HSE matters.

5.4. Supporting Staff To HSE Team

i. Supporting Staff shall include scaffolders, scaffolding inspectors, riggers, skilled and unskilled manpower
ii. Subcontractor shall provide adequate number of workers as and when required, in order to attend and comply to Safety observations raised by BHEL/ Customer.

5.5. Availability And Penalty For Non-Deployment

i. The subcontractor shall submit the certificates of qualification & experience of HSE manpower before deployment for BHEL to assess suitability as per requirement detailed in this document
ii. In case of rejection, subcontractor shall arrange additional candidates and submit resume to BHEL. Penalties will be applicable during the period of non-deployment in such cases as well.
iii. Subcontractor shall ensure physical availability of safety personnel at the place of specific work locations.
iv. The Subcontractor shall deploy the HSE Officers as per the site's requirement. Non-deployment shall lead to stoppage of the work and final decision shall rest with Site HSE & Construction manager.
v. The Subcontractor shall prepare an organization chart identifying the areas of operations, responsibilities and reporting structure of all safety personnel for each shift and submit the same to BHEL.
vi. The subcontractor shall deploy sufficient HSE Officers, supervisors, as per numbers & qualifications mandated in this Section since mobilization of first batch of manpower and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty at following rates:

Non-deployment of HSE Officer –	Rs. 75,000 per man-month
Non-deployment of HSE Supervisor –	Rs. 50,000 per man-month

vii. Penalty shall be collected for the period of non-availability of safety personnel after allowing a grace period of 15 days for finding a replacement. The same shall be deducted on pro-rata basis till the required manpower is deployed.

viii. In case of abnormal delay & frequent rejections of candidates proposed by the subcontractor, BHEL shall exercise the right to deploy the safety manpower & deduct the amount from subcontractor's running bill with applicable overheads. In such cases also, the provision of logistics, transportation, food and other logistical support to the HSE personnel shall be in the scope of subcontractor in addition to the salary. After deployment of manpower by BHEL, the penalty for non-deployment specified above shall not be applicable.

6. COMPETENCY OF OPERATORS/ DRIVERS OF CRANE, WINCH, LIFTING/ CONSTRUCTION EQUIPMENT ETC.

i. The Operators/ Drivers of crane, winch, construction/ lifting equipment etc. shall be experienced and have valid driving license for the class of vehicle / machinery as applicable (like Crane/ Forklift/ Rig, Construction equipment driving license etc.).

ii. Minimum HMV driving license is required for all heavy equipment/ heavy vehicle (trailer/ Hyva /dumper /TM) operators at site.

iii. The subcontractor shall certify competence of these persons in writing as and when they are posted at site.

iv. Crane, Winch, Construction & lifting equipment operator should have certificate on subject course or experience certificate in employer letterhead.

v. Where state is providing license for operating crane, tractor and other construction vehicles, same to be ensured.

Note: In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act,1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above, the same shall be followed.

7. In case of any stringent requirement of BHEL's customer over and above the specifications mentioned in current document, the same shall also be required to be complied at site by subcontractor.

8. REFERENCES

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The subcontractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

8.1. FOR GREENFIELD PROJECTS

a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

8.2. For Expansion, Modification, Alteration and, Or Construction Activity Within An Existing Plant Operating As Per Approved Site Plan Under The Factories Act

a) Factories Act, 1948,
b) Factories Rules, as adopted by the various State Governments
c) BOCW Act
d) BOCW Rules
e) In case a new act/ statutory guideline/ modification/ consolidation of acts is implemented the same shall be required to be adhered by the subcontractor.
f) The latest amendment of the above-mentioned acts/ rules shall be followed at site.

9. BHEL POWER SECTOR HSE MANAGEMENT SYSTEM

The Systems and procedures of BHEL Power Sector HSE Management System shall be implemented by the subcontractor, including:

- HSE Procedure for Register of OHS Hazards and Risks
- HSE Procedure for Register of Environmental Aspects and Impacts
- HSE Procedure for Register of Regulations
- HSE Procedure for Training and Awareness
- HSE Procedure for Emergency Preparedness and Response Plan
- HSE Procedure for Permit to Work
- HSE Inspection and Other Formats

Note:

i. BHEL reserves the right to revise/ update these systems and procedure as per requirement to address any changing HSE needs

ii. BHEL will provide hard / soft copies of applicable HSE Procedures, Work Permits, Operational Control Procedures, Inspection/ Other Formats etc. that are necessary for ensuring safe work to the successful bidder at Site. It is the responsibility of the subcontractor to ensure availability of these documents before commencing work at site.

iii. The subcontractor can get soft copies of these documents from respective Region SCT/ HSE for reference. The signed hard copies of the same shall not be required to be submitted along with tender document

iv. Subcontractor shall use the Digital (Web & App-Based) HSE management Software Systems provided by BHEL whenever provided. In case not provided, hard copy systems will continue to be used. All information technology resources (Computers, mobile phones, mobile data, internet access etc.) for the use of such systems shall be ensured by the subcontractor.

10. CLEARANCE OF MONTHLY RUNNING BILLS SUBJECT TO SAFETY COMPLIANCE

i. The monthly running Bills of the subcontractor shall be released subject to compliance to HSE requirements as per checklist in Annexure H
ii. BHEL site HSE Head and Package In-charge shall be authorized to issue the clearance
iii. Site Construction Manager of BHEL shall be the final authority on the matter.

11. HSE PERFORMANCE EVALUATION

i. Subcontractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
ii. The HSE evaluation shall be based on HSE Performance Evaluation System of BHEL covering the contractual, statutory and regulatory requirements of HSE.
iii. BHEL shall reserve the right to use these performance scores for evaluating bidder's capacity for future tenders
iv. If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job, provided the execution performance is satisfactory.

12. HSE PENALTIES

i. Nonconformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the subcontractor for every instance of violation noticed.
ii. As per contractual provision HSE penalties shall be imposed on subcontractors for non-compliance on HSE requirement as per following format.
iii. Following are the applicable penalties for various Safety violations:

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty (in Rs.) is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

S. No	Nature of Non - Compliance	Penalty (in INR)	Remarks
A. System Violations			
1	Working without valid Work Permit/ HIRA/ Method Statement / JSA	2000	Per case
2	Controls as per Work Permit/ HIRA/MS/JSA not ensured	2000	Per case
3	Reported Safety Violations Not Closed within Stipulated Time	1000-10000	Per case
4	Absence of required Subcontractor Officials (Site Head, HS Head) in Safety Reviews/Meetings	5000	Per case
5	Not providing required PPEs (Safety Harness, Lifeline, Safety Net, Fall arrestor, Safety Helmet, Gloves, Shoes etc.) for the work by subcontractor	2000	Per case
B. Competency/ Training/ Induction Violations			

1	Incompetent personnel deployed for specialized jobs like height work, hot work, rigging, vehicle operation etc. (without valid license/ certificate etc.)	3000	Per case
2	Work without induction training & medical check	2000	Per case
3	Height Work without Vertigo Test and height work training	2000	Per case
C. PPE Violations – Height Work			
1	Not wearing/ hooking Double Lanyard Safety Harness while working at height (> 1.2 meters) or not anchoring to lifeline	1000	Per case
2	Not Providing Lifeline for height work	3000	
3	Unsafe platforms – without Top, Mid Rails and Toe-Guards for Height Work	3000	
4	Not providing secondary means of fall protection for height work (Safety Nets, Retractable Fall Arrestors etc.)	3000	Per case
D. PPE Violations – General			
1	Not wearing safety helmet	1000	Per case
2	Wearing of helmets without chin straps	1000	Per case
3	Not Wearing safety shoes	500	Per case
4	Not wearing gloves	500	Per case
6	Not using grinding goggles/ face shield during grinding/ cutting	2000	Per case
E. Electrical Safety Violations			
1	Broken/ exposed wires/ cables	2000	Per case per day
2	Electrical plug not used for connection/ hand machines	1000	Per case per day
3	Not using proper ELCBs for electrical equipment	2000	Per case per day
4	Improper earthing of welding & Other electrical machines (Lack of double earthing, improper/ untested earth pit etc.)	2000	Per case per day
5	Not using 24 V supply for lighting in confined spaces	2000	Per case
6	Cables haphazard/ blocking way/ not organized properly	1000	Per case per day
F. Lifting & Rigging Violations			
1	Using Sling/ Chain Pulley Block and other Small T&Ps without proper, traceable Tag and Test Certificate	2000	Per T&P per day
2	Using damaged slings or not slinging properly	2000	Per T&P per day
3	Use of lifting equipment without having valid Test certificate	5000	Per equipment per seven days
4	Lifting hooks used without latches	2000	Per hook per day
5	Not effectively barricading area below lifting activity	5000	Per case
6	Using untrained/ unqualified rigger	5000	Per case
G. Housekeeping			
1	Non-removal of scrap from platforms	5000	Per Event Per location per 7 days
2	Not conducting scheduled housekeeping drives	5000	Per drive
H. Hot Work Safety Violations			
1	Gas cutting without flash back arrestor at both ends	5000	Per machine per incidence
2	Gas cutting at height without fire blanket	2000	Per event

3	Not keeping gas cylinders vertically	2000	Per event
4	Lifting cylinders without cage or rolling of cylinders	2000	Per incidence
5	Leakage in gas cylinder	2000	Per incidence
I. Vehicle Safety/ Operation			
1	Not having valid driving license for the type of vehicle/ T&P	2000	Per driver per incidence
2	Two-wheeler entry in construction area	2000	Per vehicle
3	Using Hydra for material movement at site in unsafe manner	2000	Per case
4	Using Two Hydra in Tandem for material movement without proper precautions as per OCP	2000	Per case
5	Vehicles, Hydras, Cranes, Dumpers and Earth Movers not having automatic back horns linked to gear	2000	Per Equipment per day
6	Not providing proper hard barricades around excavations/ unpermitted areas	5000	Per location per day
7	Not using guide rope while transporting material using Hydra or Cranes	2000	Per event
8	Over speeding	5000	Per case
9	Using Conventional Hydra crane	50000	Per day /crane
J. Accidents/ Incidents/ Near Misses			
1	Non-reporting of Near Miss/ Incident	20000	Per case
2	Major Accident – Worker unable to resume work within 48 hrs	100000	Per incident
3	Fatal Accident	500000	Per incident
K. Miscellaneous			
1.	Not providing the facility (drinking water, rest shed, labor colony etc. as per the specifications/ requirement)	5000	Per month per violation
2.	Not nominating the required number of workers for training as per plan	5000	Per incidence
3.	Lack of proper arrangement for disposal of sewage/ waste water/ effluents etc.	10000	Per incidence

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.):

_____
_____
_____

Penalty Amount:

1. Rate as per above chart
2. No. of Persons/ machine/ event/ labor
3. No. of times the same error is repeated: Repetition factor
4. Total Penalty= 1. X 2. X 3. =

Witnessed by:

(Sub- Subcontractor representative) (BHEL representative)

Signature _____

_____

Name _____

_____

Distribution: 1 Copy: to Sub- subcontractor Site In-charge,
1 Copy to Site Construction Manager (BHEL)
1 Copy to Site Finance

Note:

i. In case the amount of penalty imposed by BHEL's Client on BHEL for Safety violation/ incident due to or in the area of the subcontractor is more than those indicated above, same shall be imposed back-to-back on the subcontractor. However, in case such an amount is less than the specified above, penalty amount indicated above shall be imposed on the subcontractor.

ii. For same violation only one penalty (higher of the two mentioned below) shall be applicable
   a. Penalty imposed by BHEL's Customer over BHEL.
   b. Penalty as indicated in current document.

iii. For repeated violation for the same equipment/ location, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

iv. For repeated fatal incident in the same Unit incremental penalty shall be imposed: The subcontractor will pay 2 times the previously paid penalty in case there is repeated major/ fatal incident under the same subcontractor for the same package in the same unit.

v. Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above.

vi. If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.

vii. The penalty amount shall be recovered by BHEL Finance department from subcontractors from the RA/Final bill.

13. PUNITIVE ACTIONS FOR "CRITICAL SAFETY VIOLATIONS":

"Critical Safety Violations" include:

i. Not wearing required PPEs when provided and not following safe work procedure

ii. Taking unnecessary risks especially in height work, hot work, radiation work, lifting activity

iii. Coming to work under influence of sedatives like alcohol, drugs etc.

iv. Coming to work without ID Card/ Gate Pass (if provided)

v. Intimidating/ threatening at work

vi. Using cell phones during height work, hot work, lifting activity, driving.

In case any worker carries out any of the critical safety violations as above, BHEL reserves the right to enforce punitive action in following manner:

First Offence:	1 Punch on Gate Pass/ Induction Card/ ID Card etc. and 1-hour HSE Training. With one day off from duty
Second Offence:	2 Punches and 2-hours HSE Training with one day off from duty

Third Offence:	3 Punches and the worker will be dismissed. Gate pass to be confiscated

In case any employee of subcontractor carries out any of the critical safety violations as above, subcontractor Site In-charge shall issue warning letter to concerned employee with copy to BHEL

Note:

i. For above violations, guilt of the worker/ employee has to be established through appropriate evidences and records maintained.

ii. If worker/ employee has not been given the required PPEs and safety equipment by the agency and/or not facilitated by the agency to follow safety rules, he/ she will not be considered liable but the agency will be penalized as per penalty provision in this document. In such cases, the subcontractor shall not pass the penalty over to the worker/ employee through wage deduction etc.

iii. These critical safety violations and their consequences shall be shared with all workers and employees during induction and other training programs/ meetings, toolbox talks etc.

iv. Gate Pass shall have provision of Tagging as indicated above

v. The appellate authority (only for final dismissal) in this case shall be the BHEL Site In-charge whose decision shall be final on the matter and binding on all parties.

14. LEGAL IMPLICATIONS

Any legal Costs incurred by BHEL, on account of accidents taking place in the activities of the subcontractor, shall be debited to the subcontractor on actual cost basis.
For any accident occurring at site to any worker/ employee of the subcontractor leading to legal implications to BHEL Employee/ Management shall be safeguarded by BHEL legal department. All legal expenses incurred by BHEL on this account shall be recovered from the subcontractor. The accident also includes fire, loss of property or life at site.

15. HSE REVIEW MEETING

i. Subcontractor Site In-charge and HSE In-charge shall attend the HSE Review Meeting as and when called by BHEL.
The indicative agenda points are given below:

a) Implementation of earlier MOM points
b) Compliance Status of HSE Observations
c) Incidents & Near Misses, their Root Causes and Actions Taken
d) HSE performance review
e) HSE inspection findings
f) HSE audit and CAPA
g) HSE training
h) Health check-up camp
i) HSE planning for the erection and commissioning and installation activities in the coming month

j) HSE reward and promotional activities

ii. MOM on the discussion along with HSE observations will be circulated to the subcontractor for action.

iii. The subcontractor shall close the observations to the satisfaction of BHEL within stipulated time frame

16. OTHER REQUIREMENTS

i. If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps and the cost shall be debited to the subcontractor with applicable overheads.

ii. If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.

iii. In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.

iv. The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.

v. The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

vi. The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.

vii. BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.

viii. BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

17. MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s……..do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s……..have gone through and understood all the HSE requirements of the contract including HSE manpower, tools & equipment, systems & procedures, and agree to fulfill the same as a minimum. Any additional resources and support required for ensuring fulfillment of HSE Objectives shall be provided by subcontractor at no extra cost.

M/s…….. agree that in case they fail to comply to the HSE requirements as stipulated in the contract, BHEL shall have the right to implement the same and the cost shall be recovered from the subcontractor with applicable overheads.

M/s…….. shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be imbibed in all workers and supervisors for compliance.

In addition to this, M/s……..shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s……..shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

M/s…….. agree that the subcontractor shall seek HSE clearance as per BHEL format before each RA bill as mentioned in clause no. 9. The penalty amounts for not providing Safety manpower and various Safety violations have also been reviewed and agreed.

M/s…….. agree to share the HSE Costs (running costs) of common facilities created by BHEL on proportional to contract value basis as calculated at Site by BHEL.

Signed by authorized representative of M/s ----------

Name :

Place & Date:

SECTION B

OPERATIONAL REQUIREMENTS

1. PURPOSE:

1.1. The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.

1.2. This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents in complementary manner.

1.3. Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy wherein the relevant statutory guidelines supersedes this document, the same shall be followed.

1.4. In case there's any specific HSE requirement from BHEL's Client, not explicitly indicated in this document the same shall be required to be fulfilled as per the decision of BHEL Site construction manager.

2. SCOPE:

The document is applicable to BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations

3. OBJECTIVES AND TARGETS:

i. To achieve "Zero Incident at Site"
ii. 100% compliance to all legal/statutory requirements related to EHS.
iii. 100% Health, Safety and Environmental Induction training attendance for all workers.
iv. 100% High Risk activities to be carried out only after approved Method Statement, HIRA / Aspect-Impact / JSA / OCP and Permit to Work are implemented.
v. 100% PPEs compliance in high and medium risk activities.
vi. 100% incident reporting, recording and reviewing for corrective actions.
vii. Regular Safety Reviews to assess HSE program compliance and closure of any recognized gaps to improve safety management and incident prevention
viii. Prevent injury and ill health of all workers at site ('Workers' refers to all personnel including managerial, supervisory, professional, technical, clerical and other workers including contract laborers)
ix. Prevent pollution to environment
x. Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
xi. Ensure protection of environment of the work site.
xii. Comply at all times with the relevant statutory and contractual HSE requirements.
xiii. Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
xiv. Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.

xv. Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
xvi. Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
xvii. Establish effective communication on HSE matters with all relevant parties involved in the Project works.
xviii. Ensure that all work planning considers all persons that may be affected by the work.
xix. Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
xx. Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
xxi. Ensure continual improvements in HSE performance.
xxii. Ensure conservation of resources and reduction of wastage.
xxiii. Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
xxiv. Ensure timely implementation of correction, corrective action and preventive action. The subcontractor shall also comply with HSE Targets stipulated by BHEL from time to time.

4. BHEL HEALTH, SAFETY & ENVIRONMENT POLICY:

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, subcontractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Chairman & Managing Director/ BHEL

5. ILLUSTRATIVE RESPONSIBILITIES OF SUBCONTRACTOR EMPLOYEES

5.1 HSE - A LINE RESPONSIBILITY

i. HSE is a “Line Responsibility”.
ii. The term "Line" includes management, Executives, Supervisors, Foremen, and Workers who are part of the workforce. Line is to be fully involved in HSE Planning & Implementation with the aid and advice of HSE organization.
iii. “Line”, having control of resources and manpower is responsible for overall implementation of HSE Systems and closure of HSE observations.

5.2 SITE IN -CHARGE:

i. Shall sign Memorandum of Understanding (MoU)
ii. Shall ensure availability of all necessary resources required for implementation of HSE at Site
iii. Shall engage qualified HSE Officer(s) and supervisors (s)
iv. Shall adhere to the rules and regulations mentioned in this code, practice very strictly in area of work in consultation with concerned engineer and the safety coordinator.
v. Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
vi. Shall not engage any employee below 18 years.
vii. Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job.
viii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
ix. Shall ensure closure of all HSE non-conformities reported by BHEL or observed during internal inspection by providing appropriate resources in a timely manner.
x. Shall ensure the implementation of provisions of applicable acts and rules pertaining to HSE.
xi. Shall ensure availability of updated (Hazard Identification and Risk Assessment) Register for the area of activity
xii. Shall ensure availability of Method Statements & Job Safety Analysis for all hazardous activities
xiii. Shall ensure necessary controls to minimize risk in all applicable hazardous activities including Height Work, Hot Work, Lifting & Rigging, Confined Space, Maintenance, excavation, Radiography, Loading/ Unloading, Drilling/ Blasting etc.
xiv. Shall ensure implementation of HSE requirements mentioned in this document and as specified in the BHEL HSE management System including training, inspection, awareness, reporting etc.
xv. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
xvi. Shall ensure a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) for preventing fall from height
xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.

xviii. Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
xix. Shall ensure that Horseplay is strictly forbidden.
xx. Shall ensure that adequate illumination is arranged during night work.
xxi. Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
xxii. Shall ensure display of adequate signage/posters on HSE.
xxiii. Shall ensure that mobile phone is not used by workers while working.
xxiv. Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
xxv. Shall ensure full co-operation during HSE audits.
xxvi. Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
xxvii. Shall ensure good housekeeping.
xxviii. Shall ensure adequate valid fire extinguishers are provided at the work site.
xxix. Shall ensure availability of sufficient number of toilets (preferably bio-toilets) /restrooms and adequate drinking water at work site and labor colony.
xxx. Shall ensure adequate emergency preparedness.
xxxi. Shall be member of site HSE committee and attend all meetings of the committee
xxxii. Power source for hand lamps shall be maximum of 24 v.
xxxiii. Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available
xxxiv. To record all incidents including near miss and report to BHEL and to ensure analysis & corrective actions for the same
xxxv. Shall conduct weekly Safety Walks in the work area and record the findings.
xxxvi. Construction of Canteen at Site, Office Infrastructure: Printer, PC, Fire Extinguishers etc.
xxxvii. Shall analysis HSE Performance regularly in work area and take steps to improve the same
xxxviii. Shall ensure stoppage of work in case of unacceptable Safety hazards

5.3 HSE OFFICER:

i. Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
ii. Facilitate inclusion of safety elements into Work Method Statement and creation of Job Safety Analysis (JSA)
iii. (HSE Head) To prepare deployment plan of HSE personnel for all shifts, so as to ensure constant supervision of all areas. The plan to be submitted to BHEL
iv. Highlight the requirements of safety through Tool-box / other meetings.
v. Help concerned HOS to prepare Job Specific instructions/ JSA for critical jobs.
vi. Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
vii. Advice & co-ordinate for implementation of HSE Systems & Procedures.
viii. To stop work in case of any critical safety violation until the violation is cleared
ix. Convene HSE meeting & minute the proceeding for circulation & follow-up action.

x. Plan procurement of PPE & Safety devices and inspect their healthiness.
xi. Report to BHEL on all matters pertaining to status of safety and promotional program at site level.
xii. Facilitate administration of First Aid
xiii. Facilitate screening of workmen and safety induction.
xiv. Conduct fire Drill and facilitate emergency preparedness
xv. Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
xvi. Apprise BHEL on safety related problems.
xvii. Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
xviii. Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
xix. To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
xx. Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
xxi. Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters.

5.4 HSE SUPERVISOR:

i. All requirements as per 5.1
ii. To monitor allotted area for Safety violations, take required action and inform the concerned Safety Supervisor / Officer
iii. To assist HSE Officer

5.5 PACKAGE IN-CHARGES, ENGINEERS & ALL EMPLOYEES:

i. To be aware of, get involved in and ensure implementation of all HSE related Systems and Procedures including but not limited to:
    a. BHEL HSE Management System including HSE Procedures and OCPs, HIRA, JSA etc.
    b. Work Permit System
    c. Emergency Preparedness Response Plans
    d. Contractual HSE requirements
    e. Legal Requirements
    f. Penalty System
    g. Training requirements
ii. To ensure that the persons engaged in respective area follow the safety rules like using appropriate PPEs.
iii. To develop Method Statements and ensure availability of Job Safety Analysis for all activities in scope
iv. To ensure that the reported HSE non-conformities in the work area are resolved immediately before resuming work
v. To record all incidents including near miss and report to BHEL.

vi. To adopt safe working practices at all times and act as role model for Safety
vii. To take immediate corrective action actions in case any non-conformity is observed on product / process / system with respect to Occupational Health, Safety and Environment.
viii. In case any particular activity / work has extremely high consequential risk or high environmental impact, same shall be brought to the notice of BHEL Package In-charge before starting the work.
ix. To interfere/ stop work as & when identified unsafe.
x. To maintain & promote improved level of house-keeping all the time at site.
xi. To support/co-operate with audit team members as & when safety audits are carried out.
xii. To involve in investigation, if any incident occurs in his work area.
xiii. To participate in safety promotional programs
xiv. To attend the safety committee meeting, if member/invitee
xv. To ensure that only fit T&Ps and qualified persons are engaged for all activities.
xvi. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
xviii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.

6. HSE PLANNING BY SUBCONTRACTOR:

6.1 HAZARD ANALYSIS & RISK ASSESSMENT (HIRA), METHOD STATEMENT (MS) & JOB SAFETY ANALYSIS (JSA):

i. Subcontractor shall identify all OHS Hazards and Risks applicable to all activities in scope and plan & implement the required control measures. HIRA Register shall be maintained.
ii. Subcontractor shall develop Method Statements & Job Safety Analysis documents for all hazardous activities in scope and ensure the required control measures. Job Safety Analysis is to be attached along with any Work Permit request

6.2 REGISTER OF REGULATIONS:

Subcontractor shall prepare a register of applicable rules and regulations in the scope and plan to ensure compliance.

HIRA Register, Method Statements, Job Safety Analysis and Register of Regulations are dynamic documents and shall be revised (as applicable):

i. At fixed frequency of 3 months
ii. Addition/ deletion/ modification of a process/ activity
iii. After an accident/ incident
iv. After any change in applicable rules/ regulations/ laws.

6.3 MONTHLY HSE PLAN COVERING THE FOLLOWING AS A MINIMUM SHALL BE PREPARED AND SUBMITTED TO BHEL FOR APPROVAL:

i. HSE Trainings covering all activities/ hazards/ workers

ii. HSE Inspection Plan covering all areas/ activities/ equipment/ hazards

iii. HSE Activities: Safety walks, Awards, housekeeping, reviews etc.

Note: Online/ App-based system shall be used for HSE Planning and Implementation/ Update whenever provided by BHEL otherwise Hard-copy based system shall continue

6.4 MONTHLY HSE PLANNING & REVIEW OF HSE ACTIVITIES ALONG WITH BHEL:

Monthly planning and review of HSE activities shall be carried out by subcontractor as per provided **format** jointly along with BHEL

7. MOBILIZATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR:

i. Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

ii. As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable. Inspection by Third Party competent person shall be arranged:
   a. Before first time use at site
   b. After carrying out any modification
   c. After repairs subsequent to involvement in any accident/ incident

iii. As a further measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and comply with legislative and owner requirement, inspection as per provided format shall be arranged by in-house expert / competent authority (preferable) for acceptance. The equipment considered for this purpose shall include all those in the T&P list in the tender document.

8. MOBILIZATION OF MANPOWER BY SUBCONTRACTOR:

i. As a measure to ensure that manpower being mobilized to the construction site is fit and competent for safe working, screening arrangement shall be made by the sub-subcontractor to ensure competency and fitness through following measures:

a) **Medical Checkup:** Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed as per provided **format**. For height workers, vertigo (height phobia) test to be carried out as qualification criteria as per Annexure K and recorded in provided **format**.

b) **Induction Training**: Induction training of all workers to be ensured as per **provided procedure and format**. Training evaluation to be carried out and training to be repeated if not passed

c) Only on successfully meeting above criteria, permanent gate passes to be issued

ii. The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.

iii. The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.

iv. Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.

v. Appropriate accommodation to be arranged for all workmen in hygienic condition.

vi. Cost of contractual, statutory and regulatory requirements like Training, medical checks, PPEs etc. shall not be transferred to the workers and such activities shall be considered as part of the job.

9. Provision of Personal Protective Equipment (PPEs):

i. Personnel Protective Equipment (PPEs), shall be provided by the subcontractor to all workers as per requirement of the job.

ii. The choice of PPEs to ensure multiple (at least more than 1) means of protection against any hazard. All applicable safety precautions for a job shall be ensured notwithstanding the duration or perceived importance of the task.

iii. The applicability of PPEs shall be as per the concept of Hierarchy of controls, i.e.:

iv. Elimination->Substitution->EngineeringControls->AdministrativeControls-PPEs

v. Relying solely on PPEs without ensuring necessary controls to be strictly avoided.

vi. The following matrix recommends usage of minimum PPEs against the respective job.

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space
Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLFBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	

Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP/ EM	CA	SAMH	-	

ABBREVIATIONS: FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA: Online breathing apparatus

The list is not exhaustive. Additional PPEs to ensure Safe Work may need to be deployed as per the requirement of the task at no additional cost.

vii. The PPEs shall conform to the relevant standards as below (illustrative list) and bear ISI mark.

RELEVANT IS-CODES FOR PERSONAL PROTECTION

PPEs	IS Codes
Industrial Safety Helmets.	IS: 2925 – 1984
Rubber gloves for electrical purposes.	IS: 4770 – 1968
Industrial Safety Gloves (Leather &Cotton Gloves).	IS: 6994 – 1973 (Part-I)
Leather safety boots and shoes.	IS: 1989 – 1986 (Part-I-II)
Industrial and Safety rubber knee boots.	IS: 5557 – 1969
Code of practice for selections care and repair of Safety footwear.	IS: 6519 – 1971
Leather Safety footwear having direct molding sole.	IS: 11226 – 1985
Eye protectors.	IS: 5983 – 1978
Ear protectors.	IS: 9167 – 1979
Eye & Face protection during welding	IS: 1179-1967
Industrial Safety Belts and Harness	IS: 3521 – 1983
Guide for selection of industrial Safety equipment for body protection	IS:8519 -1977
Respiratory Protective Devices	IS:9473-2002,14166-1994,14746-1999

viii. Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public

ix. All the personnel and visitors shall mandatorily use safety helmet (with company logo), safety shoe and reflective vests, in addition to any other PPEs as deemed appropriate for the area of work/ visit.

x. Following Color scheme for Helmets shall be followed:
   a. Workmen: Yellow
   b. Safety staff: Green or white with green band
   c. Electrician: Red
   d. Others including visitors: White
   e. For height workers, special marking on helmets besides indication on Gate Pass/ ID Card

xi. The subcontractor shall maintain register for issue and receipt of PPEs.

xii. All the PPEs shall be checked for quality before issue and the same shall be periodically re-checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be replaced.

xiii. The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.

xiv. The body harnesses shall be serial numbered.

10. ARRANGEMENT OF INFRASTRUCTURE:

10.1 DRINKING WATER:

i. Drinking water shall be provided and maintained at suitable places at different elevations such that minimum quantity of 5 liters is available for each worker during the day.

ii. Drinking water tank shall be so installed so as to be available within 200 meters of each working area

iii. Container should be labeled as “Drinking Water” in languages understood by the workers

iv. Cleaning of the container shall be ensured at least once in a week. Mild cleaning detergents as used for cleaning vessels shall be applied and scrubbers (3M or equivalent) shall be used for removing scales and deposits on the inside surface. The tank shall be thoroughly cleaned with potable water only before it is refilled (also applicable to labor colony).

v. Suitability of water source for drinking to be tested as per IS10500 at least once in six months.

10.2 WASHING FACILITIES:

i. In every workplace, adequate and suitable facilities for washing shall be provided and maintained.

ii. Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.

iii. Water suitable for washing and not for drinking shall be clearly indicated as “Not for Drinking” in language understood by workers.

iv. Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

10.3 LATRINES AND URINALS:

i. Latrines and urinals shall be provided in every work place as indicated in Section A
ii. Urinals shall also be provided at different elevations.
iii. They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
iv. Separate facilities shall be provided for the use of male and female worker if any.

10.4 PROVISION OF REST SHEDS FOR WORKERS DURING REST PERIOD:

Proper Rest Shed (s) with shelter shall be provided for rest during break so as to accommodate all workers as indicated in Section A

10.5 MEDICAL FACILITIES:

10.5.1 GENERAL

i. Provision of Medical Center, Ambulance etc. shall be as per Section A of this document
ii. Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste – Management and Handling Rules, 1998)
iii. Every injury shall be treated, recorded and reported.
iv. All First Aid injuries shall be recorded as per provided Format
v. List of qualified first aiders and their contact numbers to be displayed at conspicuous places.

10.5.2 FIRST AIDER/ FIRST AID BOX

i. The first aider along with facilities should be available at a point nearest to the work location wherein majority of the workers are working.
ii. The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
iii. The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
iv. The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
v. The first aid box shall be distinctly marked with a Green Cross on white background.
vi. Details of contents of first aid box is given in Annexure J
vii. A slip of contents shall be pasted on the First Aid Box with following details
viii. Monthly inspection of First Aid Box shall be carried out by the owner as per provided format
ix. The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

10.5.3 HEALTH CHECK UP

The persons engaged at the site shall undergo health check-up as per provided format before induction. In addition, the persons engaged in the following works shall undergo health check-up at least once in a year:

i. Height workers
ii. Drivers/crane operators/riggers
iii. Confined space workers
iv. Shot/sand blaster
v. Welding and NDE personnel

10.5.4 HEIGHT PHOBIA/ VERTIGO TEST:

i. The persons engaged in working at heights (above 2 meters) to be assessed for Vertigo and associated conditions and recorded as per provided format. Suggested Vertigo Test Procedure is given in Annexure K
ii. Such workers are to be allowed only on successful completion of test, otherwise shall be allocated ground-based jobs.
iii. IDs / Height passes shall be issued to such workers, besides special markings on helmets for easy identification.

10.5.5 PROVISION OF CANTEEN FACILITY:

i. Canteen facilities shall be provided for the workmen of the project inside the project site where worker strength is 250 or more.
ii. Proper cleaning and hygienic condition shall be maintained.
iii. Proper care should be taken to prevent biological contamination.
iv. Adequate drinking water should be available at canteen.
v. Fire extinguisher shall be provided inside canteen.
vi. Regular health check-up and medication to the canteen workers shall be ensured as per applicable regulations.
vii. Canteen waste to be disposed of in hygienic manner

10.6 PROVISION OF ACCOMMODATION/LABOR COLONY FOR WORKFORCE:

i. Proper accommodation for workforce to be provided in line with minimum requirements indicated in Section A
ii. Labor colony shall be inspected each week by HSE Officer and report submitted to BHEL as per provided format

10.7 PEST CONTROL:

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labor colony and stores.

10.8 SCRAPYARD:

i. In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
ii. Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

10.9 ILLUMINATION:

i. The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.
ii. Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
iii. Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
iv. Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.
v. Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II).

SUITABLE ILLUMINATION LEVELS FOR VARIOUS AREAS SHALL BE DECIDED BASED ON BROAD GUIDELINES INDICATED BELOW:

S. No.	Location	Lux Level (lumens/sqm)
A.	**Construction Site**	
1	Outdoor areas like store yards, entrance and exit roads	20
2	Platforms	50
3	Entrances, corridors and stairs	100
4	General illumination of work area	150
5	Rough work like fabrication, assembly of major items	150
6	Medium work like assembly of small machined parts	300
7	Fine work like precision assembly, precision measurements etc.	700
8	Sheet metal works	200
9	Electrical and instrument labs	450
B.	**Office**	
1	Outdoor area like entrance and exit roads	20
2	Entrance halls	150
3	Corridors and lift cars	70
4	Lift landing	150
5	Stairs	100
6	Office rooms, conference rooms, library reading tables	300
7	Drawing table	450
8	Manual telephone exchange	200

vi. Illuminations shall be inspected on weekly basis as per provided **format** using a calibrated lux meter.

11. HSE TRAINING & AWARENESS:

11.1 TRAINING PLAN:

i. All training programs to be carried out in a planned manner. Monthly/ Annual Training Calendar to be submitted to BHEL for approval and shall cover HSE Training requirements of all activities, workers, hazards applicable to the area(s) of work.
ii. Subcontractor shall nominate workers as per the schedule of specific training plan, failing which, penalty shall be imposed.
iii. Training records of all workers along with attendance, signatures, faculty details etc. shall be maintained in soft/ hard copy as per provided **formats**.
iv. Each labor should undergo at least 0.5% of total man-hours worked in HSE training.

11.2 HSE INDUCTION TRAINING

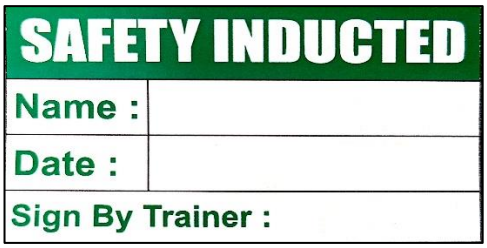
i. All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.
ii. The induction training shall be imparted through audio-visual medium (Classroom specialized training), and shall be minimum of 1 Complete Day.
iii. Evaluation to be carried out after training and training shall be repeated in case of failure.
iv. Safety Induction Card shall be printed by Subcontractor and provided to all trained workers. A Safety induction book shall also be printed and issued to each worker after induction training (Format for the same may be provided by BHEL).
v. Induction training subjects shall include but not limited to:

   a. Briefing of the Project details.
   b. Safety objectives and targets.
   c. Site HSE rules.
   d. Critical Safety Violations and consequences
   e. Site HSE hazards and aspects.
   f. First aid facility.
   g. Emergency Contact No.
   h. Incident & Near Miss reporting.
   i. Fire prevention and emergency response.
   j. Rules to be followed in the labor colony (if applicable)
   k. Accident case studies

vi. General:

   a. Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
   b. They must arrive fully dressed in safety wear & gear to attend the induction.
   c. Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.

d. On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form to declare that he had understood the content and shall abide to follow and comply with safe work practices.
e. They may only then be qualified to be issued with a personal I.D. card, for access to the work site subject to clearing the medical fitness test.



ABOVE STICKER SHALL BE PASTED ON HELMET OF WORKERS AFTER SAFETY INDUCTION TRAINING

11.3 JOB-SPECIFIC SKILL BASED HSE TRAINING

The contracting agency shall also impart job specific skill-based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge as per provided format.

TRAINING MATRIX

Name of topic	Executives	Supervisors	Skilled Workmen	Other Workers
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y

Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators

Y=YES

Note:

i. Subcontractor shall prepare a training plan/ matrix covering all hazards and implement the same after approval of BHEL.
ii. It is to be ensured that every worker undergoes Job-Specific training once every 3 months.
iii. Records of training programmes along with attendance shall be maintained by the subcontractor
iv. Each worker to be issued a Card indicating the types of trainings undergone.

11.4 HSE TOOL-BOX TALK:

i. HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work and shall be randomly attended by subcontractor engineers/ officials. The agenda shall consist of the following:

   a. Details of the job being intended for immediate execution.
   b. The relevant hazards and risks involved in executing the job and their control and mitigating measures.
   c. Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
   d. Recent non-compliances observed.
   e. Appreciation of good work done by any person.
   f. Any doubt clearing session at the end.

ii. Tool box talk to be conducted before start of work in every shift.
iii. During toolbox talk, visual check-up of workers regarding health, any signs of fatigue, intoxication etc. shall be conducted and any suspected workers to be acted upon.
iv. Record of Tool box talk shall be maintained as per provided **format**

11.5 TRAINING ON HEIGHT WORK:

i. Training on height work shall be imparted to all workers working at height by in-house/external faculty at least once every 3 months.
ii. For Height Workers Separate pass shall be provided by the subcontractor.
iii. The training shall be of minimum 2-hour duration, through audio-visual medium and followed by evaluation. In case of poor scoring, training shall be repeated.
iv. The training shall include following topics:

   a. Proper use of PPEs – safety harness, lanyard, fall arrester, retractable fall arrester, life line, safety nets etc.
   b. Provision of secondary means of fall protection

c. Safe climbing through monkey ladders.
d. Inspection of PPEs.
e. Medical fitness requirements.
f. Mock drill on rescue at height.
g. Dos & Don'ts during height work.
h. Accident case Studies

11.6 Re-Induction Training

The induction training shall be repeated for every worker after at least 1 year and shall be a pre-requisite for renewal of Gate Pass/ ID card.

11.7 Penalty Training

The personnel involved in Safety Violations/ Incidents shall mandatorily undertake penalty training pertaining to the violation/ incident. Penalty training shall be at least half-day duration.

11.8 HSE Promotion-Signage, Posters, Competition, Awards etc.:

i. HSE Displays shall be installed as indicated in Section A
ii. Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely.
iii. Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.
iv. Safety suggestion boxes shall be kept at each subcontractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.
v. Safety awareness campaigns, competitions, plays, movie shows, songs etc. to be organized for workers at Site and Labor colony from time to time to enhance Safety Awareness

11.9 HSE Rewards & Incentive Scheme

Subcontractor shall implement a reward & incentive scheme for workers & supervisors displaying adherence to safety principles. Such workers shall be felicitated in a monthly function, attended by Subcontractor top management and BHEL representatives. Suitable gift shall be given to such workers for encouragement.

11.10 HSE Awareness Program for Officials:

Subcontractor shall arrange monthly HSE awareness program on different topics including medical awareness for all engineers/ supervisors / officials working at site. This program can be part of progress/ safety review meetings.

12. HSE COMMUNICATION AND PARTICIPATION:

12.1 HSE INCIDENT REPORTING, INVESTIGATION & CORRECTIVE ACTION:

i. All incidents (near misses, property damage, first-aid cases, minor, major and fatal incidents) shall be reported to BHEL as they happen immediately through SMS and Hard/Soft copy as per provided format

ii. All incidents including near miss, minor, major and fatal incidents shall be recorded

iii. All incidents shall be investigated for Root Causes and corrective actions ensured to prevent recurrence shall be implemented.

iv. Work shall be put on hold in the area till corrective actions are verified by BHEL

v. The Root Cause Analyses and Corrective actions taken shall be recorded

12.2 HSE EVENT REPORTING:

i. Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines

ii. Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

12.3 MONTHLY HSE REPORTING:

i. All routine and non-routine HSE activities shall be reported to BHEL on monthly basis by the subcontractor as per provided format. The reporting medium can be hard/soft as per BHEL requirement.

ii. The period of reporting shall be 25th of the preceding month to 24th of the present month and shall be submitted by the end of the calendar month.

iii. Report shall include good quality images of HSE Activities

12.4 DAILY HSE ACTIVITY REPORTING:

Daily HSE activities shall be reported by subcontractor to BHEL as per provided format

12.5 HSE SUGGESTIONS:

All workers and employees shall be encouraged to provide suggestions for improvement in Health, Safety & Environment performance at site. The suggestions shall be recorded in a “Suggestions Register” as per provided format. Suggestions found suitable for implementation shall be implemented and recognition / reward to be given to the submitter.

Suggestion Register to be placed at Site and Labor Colony and shall be reviewed on periodic basis

12.6 CLIENT COMMUNICATION:

All HSE related communication from BHEL, customer / external statutory and regulatory agencies to be handled on priority. Same to be recorded and issues to be resolved in expeditious manner

13. SAFETY DURING WORK EXECUTION:

Safety during work execution shall be ensured by following appropriate Safety Rules, providing adequate resources, deploying competent and trained manpower, regular training & inspection and non-conformity resolution. Main aspects are indicated as under:

13.1 OPERATIONAL CONTROL PROCEDURES:

In order to reduce the risk associated with hazardous activities, applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions, outcomes of Hazard Analysis & other requirements. This will be done as part of normal scope of work. Illustrative list of reference OCPs is given below.

TABLE 13.1 ILLUSTRATIVE LIST OF REFERENCE OCPS

No.	Topic	No.	Topic	No.	Topic
0	General Safety	**22**	Steam blowing	**44**	Material preservation
1	Handling of chemicals	**23**	Working in confined area	**45**	Electro-resistance heating
2	Electrical safety	**24**	Operation of passenger lift, material hoists & cages	**46**	Blasting
3	Energy conservation	**25**	Vehicle/ Crane maintenance	**47**	Transformer charging
4	Welding and gas cutting operation	**26**	Radiography	**48**	Handling of battery system
5	Fire safety	**27**	Waste disposal	**49**	DG set
6	Use of hand tools	**28**	Handling & storage of mineral wool	**50**	Sanitary maintenance
7	First aid	**29**	Working at night	**51**	Piling rig operation
8	Food safety at canteen	**30**	Computer operation	**52**	Passivation
9	Use of cranes	**31**	Storage in open yard	**53**	EDTA Cleaning
10	Storage and handling of gas cylinders	**32**	Drilling, reaming and grinding(machining)	**54**	Chemical cleaning of Pre boiler system
11	Manual arc welding	**33**	Stress relieving	**55**	Boiler Light up
12	Use of helmets	**34**	Hydraulic test	**56**	Rolling and Synchronization
13	Good house keeping	**35**	Trial run of rotary equipment	**57**	Loading of Unit

14	Safe excavation	**36**	Batching	**58**	Air compressor
15	Working at height	**37**	Cable laying/tray work	**59**	Hydra Operation
16	Filling of hydrogen in cylinder	**38**	Spray insulation	**60**	Duct Pre-assembly
17	Illumination	**39**	Compressor operation	**61**	Resumption of construction activities after lockdown and prevention of coronavirus infection during site operations
18	Handling and erection of heavy metals	**40**	Gas distribution test		
19	Acid cleaning	**41**	Cleaning of Hot well / Deaerator		
20	Oil flushing	**42**	Electrical maintenance	**61A**	Prevention of Covid-19 infection in labour colony
21	Alkali boil out	**43**	O&M of control of AC plant & system	**62**	Truss/ Structure fit-up and alignment

a. The reference OCPs shall be suitably modified by subcontractor as per specific requirements to control the hazards.

b. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will prepare and follow those as well.

13.2 Work Permit System:

i. The following activities shall be carried out by the subcontractor strictly after obtaining Permit to Work from BHEL
   a) Height working
   b) Hot working
   c) Confined space Work
   d) Excavation more than 2-meter depth
   e) Radiography
   f) Heavy / Complex / Critical Lifting Activity
   g) Night / Holiday Work
   h) Material Loading / Unloading
   i) Grating, Safety Net, Safety Facility Removal
   j) Live Electrical Maintenance etc. - Lockout / Tagout
   k) Beam / truss/ duct/ structure alignment

ii. The Work Permit Formats shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability

iii. The above list is not exhaustive. BHEL reserves right to introduce additional Permits or modify requirements for usage of existing Permits. The conditions for using the Permit are specified in the Format (General Requirements).

iv. Where customer is having separate Work Permit System the same shall be followed in conjunction / merged to ensure all activities and checks are covered in all systems.

v. Details of working Group to be attached along with work permit request.

vi. All the Permits along with JSA/HIRA must be initiated by Agency Execution Team
vii. Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
viii. All Permit signatories (including subcontractor's package in-charge and HSE Officer) shall physically visit the work area and check that all the safety control measures necessary for the activity are in place. Only then the permit shall be issued.
ix. Signatory shall physically visit the area of work and ensure all required safeguards before signing the Permit
x. Signatory shall periodically visit the area to confirm the availability of required safeguards throughout the currency of the permit
xi. In case any Permit requirement is not available, work will be stopped till it is made available
xii. Permit holder shall implement and maintain all control measures during the period of permit. The permit will be closed after completion of the work.
xiii. Online Work Permit System shall be used whenever provided by BHEL, otherwise hard copy shall be used

13.3 Activity-Specific Precautions/ Controls

Detailed HSE precautions for various activities undertaken at Site by the subcontractors are specified in **Annexure I**. Same are to be ensured by the Sub-subcontractor while carrying out respective activities at Site

Index of **Annexure I** is given as under

14. ENVIRONMENTAL CONTROL & SOCIAL RESPONSIBILITY

i. Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Banned substances like asbestos and Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

ii. Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).

iii. In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

iv. All subcontractors shall be responsible for the cleanliness of their own areas

v. Regular dust suppression using sprinklers shall be carried out in respective area

vi. The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.

vii. It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, enhancing good relation with local populace etc.

viii. The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

15. HOUSEKEEPING

i. Keeping the work area and access roads clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings have to be done by subcontractor within quoted rate, on daily basis.

ii. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from subcontractor's bill. Such decisions of BHEL shall be binding on the subcontractor

iii. Dedicated Housekeeping gangs shall be deployed, who shall be provided all required PPEs and safety training

iv. Mass housekeeping shall be carried out for half a day in a week

v. Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.

vi. All surplus earth and debris are removed/disposed off from the working areas to identified locations.

vii. Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.

viii. All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations.

ix. Sufficient waste bins shall be provided at different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high locations.

x. Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.

xi. Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.

xii. Labor camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.

xiii. Fabricated steel structures, pipes & piping materials shall be stacked properly.

xiv. No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.

xv. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

16. WASTE MANAGEMENT

i. Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

ii. Details of E-Waste, Hazardous Waste, biomedical waste etc. and their disposal plan, shall be submitted to BHEL every 6 months as per provided **formats**.

16.1 Bins At Work Place

i. Sufficient rubbish bins shall be provided close to workplaces.
ii. Bins should be painted yellow and numbered.
iii. Sufficient nos. of drip trays shall be provided to collect oil and grease.
iv. Sufficient qty. of broomsticks with handle shall be provided.
v. Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

16.2 Storage And Collection

i. Different types of rubbish/waste should be collected and stored separately.
ii. Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
iii. Rubbish should not be left or allowed to accumulate on construction and other work places.
iv. Do not burn construction rubbish near working site.

16.3 Segregation

i. Earmark the scrap area for different types of waste.
ii. Store wastes away from building.
iii. Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
iv. Clinical and first aid waste stored and incinerated separately.

16.4 Disposal

i. Sufficient containers and scrap disposal area should be allocated.
ii. All scrap bin and containers should be conveniently located.
iii. Provide self-closing containers for flammable/spontaneously combustible material.
iv. Keep drainage channels free from choking.
v. Make schedule for collection and disposal of waste.

16.5 Warning And Signs

i. Appropriate sign to be displayed at scrap storage area
ii. No toxic, corrosive or flammable substance to be discarded into public sewage system.
iii. Waste disposal shall be in accordance with best practice.
iv. Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

17. Traffic Management System

17.1 Safe Workplace Transport System

i. Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.

ii. Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.

iii. For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.

iv. Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.

v. Speed limits shall be clearly displayed for each kind of vehicle.

vi. Speed ramps preceded by a warning signs or marker are necessary.

vii. The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.

viii. Safest route shall be provided between places where vehicles have to call or deliver.

ix. Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

x. Safe areas shall be provided for loading and unloading.

xi. Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.

xii. Ensure road crossings are minimum and clearly signed.

xiii. Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.

xiv. Set sensible speed limits which are clearly sign posted.

xv. Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.

xvi. Forklift trucks shall not pass over road hump unless of a type capable of doing so.

xvii. Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.

xviii. Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

17.2 Traffic Route For Pedestrians

i. Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.

ii. Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.

iii. Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.

iv. Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.

v. Provide high visibility clothing for people permitted in delivery area.

17.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

i. A high level of stability.
ii. A safe means of access/egress.
iii. Suitable and effective service and parking brakes.
iv. Windscreens with wipers and external mirrors giving optimum all round visibility.
v. Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
vi. Provision of seat belts.
vii. Guards on dangerous parts.
viii. Driver protection - to prevent injury from overturning and from falling objects/materials.
ix. Driver protection from adverse weather.
x. No vehicle shall be parked below HT/LT power lines.
xi. Valid Pollution Under Control certification for all vehicles
xii. Wheel stopper shall be use during the parking of vehicle
xiii. Helper to be deployed in each vehicle as per site requirement.

17.4 DAILY CHECK BY DRIVER

1. There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.

Brakes	Mirrors	Warning signals
Tires	Windscreen waters	Specific safety systems i.e. controls & interlocks
Steering	Wipers	

2. Management should ensure that drivers carry out these checks.

17.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

i. All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.

ii. Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.

iii. All overhangs shall be made clearly visible and restricted to acceptable limits

iv. Load shall be checked before moving off and after traveling a suitable distance.

v. On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.

vi. Warning signs shall be displayed during transportation of material.
vii. All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.
viii. Wheel stopper shall be use during the parking of vehicle
ix. Helper to be deployed in each vehicle as per site requirement.

17.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

18. EMERGENCY PREPAREDNESS AND RESPONSE

i. Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by BHEL
ii. Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
iii. All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
iv. Assembly point shall be earmarked and access to the same from different location shall be shown
v. Fire exit shall be identified and pathway shall be clear for emergency escape.
vi. Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
vii. Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
viii. First aid center shall be developed at site with trained medical personnel and ambulance
ix. Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
x. Tie up with fire brigade shall be done in case customer is not having fire station.
xi. Tie up with hospital shall be done in case customer is not having hospital.
xii. Disaster Management group shall be formed at site
xiii. Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL HSE Officer as per prescribed BHEL formats
xiv. Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

19. HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSE requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

Online/ App-based HSE Inspection system shall be used for inspection whenever provided by BHEL otherwise Hard-copy based system shall continue

	OK	NOT OK
Contractor Name:		
Equipment Identification No :		
Inspection Date :		
Next Inspection Date :		
Inspected By :		

Every Inspected Equipment shall display above sticker

19.1 INSPECTION PLAN

Subcontractor shall prepare an inspection plan covering all areas/ activities/ equipment/ hazards and implement the same after getting approval of BHEL. Responsibility to ensure coverage of all areas/ activities rests with the subcontractor.

All Inspections shall be witnessed by BHEL – only then they shall be considered as valid

19.2 INSPECTION REPORTS

Monthly inspection reports as per plan shall be submitted to BHEL HSE Head

19.3 NON-CONFORMANCES

Any non-conformances identified during inspection observed shall be addressed on priority.

The responsibility of resolution shall rest with the Subcontractor Site In-charge

In case immediate closure of non-conformities is not possible:

a. work to be halted in the area
b. non-conformance to be generated and submitted to responsible person and BHEL
c. non-conformance to be resolved through responsible agency / person

Only after closure of non-conformances, work to be allowed to resume

19.4 DAILY HSE CHECKS

Both the Site Supervisors and HSE Officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites

are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

i. Personal Safety wears & gear compliance.
ii. Complying with site safety rules and permit-to-work (PTW).
iii. Positions and postures of workers.
iv. Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

19.5 Indicative List of Inspections And Periodicities

Indicative list & periodicity of Inspections is given as under. It is the responsibility of the subcontractor to develop an inspection plan covering all areas & activities in the scope.

SL. No.	Format Name	Frequency of check (if applicable)
01	Inspection of First Aid Box	Weekly
02	Inspection of PPE	Weekly
03	Inspection of T&Ps	Monthly
04	Inspection of Cranes	Monthly
05	Inspection of Winches	Monthly
06	Inspection on Height Working	Weekly
07	Inspection on Welding & Gas Cutting	Monthly
08	Inspection on Electrical Installation	Monthly
09	Inspection on Elevator	Weekly
10	Inspection of Excavation	Weekly
11	Inspection of Labor Colony	Monthly
12	Inspection of Illumination Levels	Weekly

The checklists shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability before start of work

19.5.1 Inspection Of PPE

i. PPEs shall be inspected by HSE officer at random once in a week as per provided **format** for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
ii. The applicable PPEs for carrying out particular activities are listed below.

19.5.2 Inspection Of Tools & Plants (T&Ps)

i. A master list of T&Ps shall be maintained by each subcontractor in provided **format**.
ii. All T&Ps being used at site shall be inspected by HSE officer once in a month as per provided **format** for its healthiness and maintenance.
iii. The T&Ps which require third party inspection shall be checked for its validity during inspection. The third-party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.

iv. BHEL shall be given advance intimation of Third-Party Inspection. BHEL shall associate with Inspection as per discretion.
v. The validity of T&P shall be monitored as per provided **format**

19.5.3 Inspection Of Cranes And Winches

i. Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
ii. Cranes and Winches shall be inspected by HSE officer once in a month as per provided **format** for healthiness, maintenance and validity of third-party inspection.
iii. The date of third-party inspection and next due date shall be painted on cranes and winches.
iv. The operators/drivers shall be authorized by sub-subcontractor based on their competency and experience and shall carry the I-card.
v. The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

19.5.4 Inspection Of Height Working

i. Any activity carried out at more than 2 m height is classified as height work.
ii. Inspection of height working shall be conducted daily by Supervisors before start of work to ensure safe working condition including provision of
   a. Fall arrestor
   b. Lifelines – connected to rigid & independent structure
   c. Safety nets deployed below all height work activities
   d. Fencing and barricading
   e. Warning signage
   f. Covering of opening
   g. Proper scaffolding with access and egress.
   h. Illumination
iii. For full duration of height work, constant supervision to be maintained by dedicated HSE personnel
iv. Inspection on height working shall be conducted once in a week by HSE officer as per provided **format**.
v. Medical fitness of height worker shall be ensured.
vi. Height working shall not be allowed during adverse weather.

19.5.5 Inspection Of Welding And Gas Cutting Operation

i. Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
ii. Gas cylinders shall be kept upright.
iii. Use of Flash back arrestor shall be ensured at both ends.

iv. Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per provided **format**.
v. Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
vi. Availability of fire extinguisher at vicinity shall be ensured.

19.5.6 Inspection Of Electrical Installation / Appliances

i. Ensure proper earthing in electrical installation
ii. Use ELCB at electrical booth
iii. Electrical installation shall be properly covered at top where required
iv. Use appropriate PPEs while working
v. Use portable electrical light < 24 V in confined space and potentially wet area.
vi. Inspection shall be carried out as per provided **format**.

19.5.7 Inspection Of Elevator

i. Elevators shall be inspected by concerned supervisors once in a week as per provided **format**
ii. All elevators shall be inspected by competent person and validity shall be ensured.
iii. The date of third-party inspection and next due date shall be painted on elevator.

19.5.8 Inspection Of Excavation

Excavation activities shall be inspected as per provided **format**

19.5.9 Internal/ External HSE Audits/Inspections

i. All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed of by site in a time bound manner and reported back the implementation status.
ii. Corrective action and Preventive action on HSE issues raised by certification body issued by BHEL shall be implemented by site and reported to Site management.

20. Terms and Definitions:

1. **Incident**
   Work- related or natural event(s) in which an injury, or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

2. **Near Miss:**
   An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as “Near-Miss”.

3. **Man-Hours Worked:**
   The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labors. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the

period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

4. **First Aid Cases:**
   First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

5. **Lost Time Injury:**
   Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6. **Medical Cases:**
   Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

7. **Type of Incidents & Their Reporting:**
   The three categories of Incident are as follows:

8. **Non-Reportable Cases:**
   An incident, where the injured person is given medical help and discharged for work without counting any lost time.

9. **Reportable Cases:**
   In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

10. **Injury Cases:**
    These are covered under the heading of non-reportable cases. In these cases, the incident caused injury to the person, but he still continues his duty.

11. **Total Reportable Frequency Rate**
    Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

    Number of Reportable LTI x 1,000,000/ Total Man Hours Worked

12. **Severity Rate:**
    Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:
    Days lost due to LTI x 1,000,000/ Total Man Hours Worked

13. **Incidence Rate:**
    Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:
    Number of LTIx1000/Average number of manpower deployed

14. HIRA:

Hazard Identification and Risk Assessment (HIRA) is a process of identifying Hazards in work area and then assessing them properly

15. Method Statement:

A method statement is prepared by the Execution/ Engineering Department detailing the steps, equipment, competencies and safety precautions required for carrying out any activity

16. Job Safety Analysis:

A job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In a JSA, each basic step of the job is to identify potential hazards and to recommend the safest way to do the job. Other terms used to describe this procedure are job hazard analysis (JHA) and job hazard breakdown.

17. Safety Walk:

It's conducted periodically by an official - it's a walk through a portion or whole of a site as a HSE officer who notes down HSE observations, speak to concerned workmen and supervisor on observation, get the same corrected with personal follow up- this sends out a strong message on Management's commitment to safety.

18. Heavy & Complex Lifting:

A heavy and complex lifting activity includes:

1. Lifting above 20 Tons
2. Tandem Lifting using multiple cranes
   Total load exceeding 75% of capacity of crane. Depending up the condition of cranes, hydra cranes, winch machines & other lifting accessories
3. Lift of unusual difficulty or geometry or rigging
4. Lift over operating units
5. Any other lift as decided by site HSE / Erection

19. Safety Committee:

As per the BOCW, Safety Committee shall be constituted if there are more than five hundred or more construction workers are employed at any site. As per the Factories Act, 1948 it is for 250 workers. It shall be represented by equal number of representatives of employer and construction workers.

20. Night Work:

Work conducted after sunset when only a fraction of total manpower is available

ANNEXURES

ANNEXURE A

Medical Centre & Ambulance

A. Medical Centre

1. Paramedical staff
    a. When < 500 workers, 1 Trained Male Nurse (round the clock deployment)
    b. When >=500 workers*:
        i. Registered Medical Practitioner (Qualified MBBS) to be deployed for at least 8 hours in a day, 5 days per week
        ii. 2 Trained Male Nurses (round the clock deployment)
2. All articles as per Schedule IV of BOCW Central Rules, 1998 to be made available in the Medical Centre (given under for convenience)
3. Basic Facilities/ Requirements to be provided as per location eg. Refrigerator, Air Conditioner, Anti Venom Serums etc.
4. Tie-ups with speciality hospitals to be ensured for referring serious patients

* In case the number of workers is envisaged to exceed 500, a medical practitioner is to be engaged.

SCHEDULE IV (BOCW CENTRAL RULES, 1998) ARTICLES FOR AMBULANCE ROOM
[SEE RULE 226 (C)]

i. A glazed sink with hot and cold water always available.
ii. A table with a smooth top at least 180 cm x 105 cm.
iii. Means for sterilising instruments.
iv. A couch.
v. Two stretchers.
vi. Two buckets or containers with close fitting lids.
vii. Two rubber hot water bags
viii. A kettle and spirit stove or other suitable means of boiling water.
ix. Twelve plain wooden splints 900 cm x 100 cm x 6 cm.
x. Twelve plain wooden splints 350 cm x 75 cm x 6 cm.
xi. Six plain wooden splints 250 cm x 50 cm x 12 cm.
xii. Six woollen blankets.
xiii. Three pairs of artery forceps.
xiv. One bottle of spiritus annemia aremations (120 ml).
xv. Smelling salt (60 gm).
xvi. Two medium size sponges.
xvii. Six hand towels.
xviii. Four kidney trays.
xix. Four cakes of toilet, preferably antiseptic soap.
xx. Two glass tumblers and tow wine glasses.
xxi. Two clinical thermometers.
xxii. Two tea spoons.
xxiii. Two graduated (120 ml) measuring glasses.
xxiv. Two minimum measuring glasses.
xxv. One wash bottle (1000 cc) for washing eyes.
xxvi. one bottle (one litre) carbolic lotion 1 to 20.
xxvii. Three chairs.
xxviii. One screen.
xxix. One electric hand torch.
xxx. Four first-aid boxes or cupboards stocked to the standards prescribed in
xxxi. An adequate supply of tetanus toxide.
xxxii. Injections—morphia, pethidine, atrophine, adrenaline, coramine, novocaine (6 each).
xxxiii. Cramine liquid (60 ml).
xxxiv. Tablets—antihistaminic antispasmodic (25 each).
xxxv. Syringes with needles—2 cc, 5 cc, 10 cc and 500 cc.

xxxvi. Three surgical scissors.
xxxvii. Two needle holders, big and small.
xxxviii. Suturing needles and materials.
xxxix. Three dissecting forceps
xl. Three dressing forceps
xli. Three scalpels.
xlii. One stethoscope and a B. P. apparatus.
xliii. Rubber bandage—pressure bandage.
xliv. Oxygen cylinder with necessary attachments.
xlv. Atropine eye ointments.
xlvi. I. V. Fluids and sets 10 nos.
xlvii. Suitable, foot operated, covered, refuse containers.
xlviii. Adequate number of sterilised, paired, latex hand gloves.

B. Ambulance

1. When number of workers is <500:
   If the distance to a major hospital capable of handling critical injuries expected at Site is <= 50 KM from Site, then 1 BLS (Basic Life Support)/ Type B Ambulance otherwise ALS* (Advanced Life Support)/ Type D Ambulance
2. If no. of workers increases to >2000 workers one additional BLS Ambulance to be deployed
3. Minimum Articles as per Schedule V of BOCW Central Rules to be ensured in each Ambulance. (given under for convenience)

*Final call to be taken at Site in consultation with all the contractors

SCHEDULE V (BOCW CENTRAL RULES, 1998)
CONTENTS OF AMBULANCE VAN OR CARRIAGE
[SEE RULE 227]

The Ambulance Van shall have equipment prescribed as under:

a) General—a portable stretcher with folding and adjusting devices with the Head of the stretcher capable of being tilted upward. Fixed suction unit with equipment. Fixed oxygen supply with equipment. Pillow with case, sheets, blankets, towels, emergency bag, bed pan, urinal glass.
b) Safety Equipment-Flaros with life of three thousand minutes, floor lights, flash lights, fire extinguishers (dry power type), insulated guntlets.
c) Emergency Care Equipment—
   i. **Resuscitation**—Portable suction unit, portable oxygen unit, bag valve mask, hand operated artificial ventilation unit, airways, mouth gag tracheostomy adapters, short spine board, I.V. FLUIDS with administration unit, B. P. manometer cuff stethoscope.
   ii. **Immobilisation**—Long and short padded boards, wire ladder splints, triangular bandage—long and short spine boards.
   iii. **Dressing**-Gauze pads—100 m x 100 mm universal dressing 250 x 1000 mm, roll of aluminium foils—soft roller bandages 150 mm x 5 mm yards adhesive tape in 75 mm roll safety pins, bandage sheets, burn sheets.
   iv. **Poisoning**—Syrup of Ipecac, activated charcoal pre packeted dose, snake bit kit, drinking water.
   v. **Emergency Medicines**—As per requirement (under the advice of construction Medical Officer).

ANNEXURE A.1

Sample calculation for deduction of operational cost of facilities

Annexure A.1

Cost Calculation Methodology of Operation of Facilities (Data is indicative only)

(Period of 48 months is considered - shall be on actual basis)

A. Project Info:

Total time of Project	48 months
Project cost	1000 Crore
No. of packages	10 (A1-A10)

B. Item-wise Calculation:

Item	Nos.	Rate	Unit	Amount
Ambulance with Driver	2		Monthly/Unit	170000
Nurse/First aider	2 X 2 shifts	15000	Per month	30000
Training center one time cost	1	100000	Once	100000
Medical center one time cost	1	200000	Once	200000
Medicines at medical center	1	10000	Monthly	10000
Dust supression water tank	2	2000	Monthly	4000
Doctor	1	70000	Monthly	70000
Cleaning staff	1	12000	Monthly	12000
			Recurring monthly expenditure	296000
			Total one-time expenditure	300000

C. Package-wise Deduction Plan for a period of 48 months

Period (In Months)	6	36	6
	For 1-6 months	For 7-42 months	For 43-48 months
Cost to be incurred from contractors	7%	81%	12%
	1.17% per month	2.25% per month	2.00% per month

D. Calculation For One-Time Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10			
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000		
Share of common facilities one time running cost (in Thousands)	4	11	86	9	21	64	43	43	11	9	Individual Pkg value X Total one time running cost / All Pkg award values		
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48			
Month Count of work	6	8	47	31	9	39	43	34	9	8			
Deduction per month (in Thousands)	1	1	2	0	2	2	1	1	1	1	Total of One time Running cost (in thousands)	% deduction share of one time running cost per month	Nos. of active packages in month
Month No.													
1	1	1									2	1%	2
2	1	1	2								4	1%	3
3	1	1	2								4	1%	3
4	1	1	2								4	1%	3
5	1	1	2								4	1%	3
6	1	1	2	0			1				5	2%	5
7		1	2	0	2		1	1			8	3%	6
8		1	2	0	2		1	1			8	3%	6
9			2	0	2		1	1			7	2%	5
10			2	0	2	2	1	1			8	3%	6
11			2	0	2	2	1	1			8	3%	6
12			2	0	2	2	1	1			8	3%	6
13			2	0	2	2	1	1			8	3%	6
14			2	0	2	2	1	1			8	3%	6
15			2	0	2	2	1	1			8	3%	6
16			2	0		2	1	1			6	2%	5
17			2	0		2	1	1			6	2%	5
18			2	0		2	1	1			6	2%	5
19			2	0		2	1	1			6	2%	5
20			2	0		2	1	1			6	2%	5
21			2	0		2	1	1			6	2%	5
22			2	0		2	1	1			6	2%	5
23			2	0		2	1	1			6	2%	5
24			2	0		2	1	1			6	2%	5
25			2	0		2	1	1			6	2%	5
26			2	0		2	1	1			6	2%	5
27			2	0		2	1	1			6	2%	5
28			2	0		2	1	1			6	2%	5
29			2	0		2	1	1			6	2%	5
30			2	0		2	1	1			6	2%	5
31			2	0		2	1	1			6	2%	5
32			2	0		2	1	1			6	2%	5
33			2	0		2	1	1			6	2%	5
34			2	0		2	1	1			6	2%	5
35			2	0		2	1	1			6	2%	5
36			2	0		2	1	1			6	2%	5
37			2			2	1	1			6	2%	4
38			2			2	1	1			6	2%	4
39			2			2	1	1			6	2%	4
40			2			2	1	1	1		7	2%	5
41			2			2	1		1	1	7	2%	5
42			2			2	1		1	1	7	2%	5
43			2			2	1		1	1	7	2%	5
44			2			2	1		1	1	7	2%	5
45			2			2	1		1	1	7	2%	5
46			2			2	1		1	1	7	2%	5
47			2			2	1		1	1	7	2%	5
48			2			2	1		1	1	7	2%	5
Total	4	11	86	9	21	64	43	43	11	9	300	100%	

D. Calculation For Recurring Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10		
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000	
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48	Total of Recurring cost (in thousands)	Nos. of active packages in month
	6	8	47	31	9	39	43	34	9	8		
Month No.												
1	85	211									296	2
2	13	31	252								296	3
3	13	31	252								296	3
4	13	31	252								296	3
5	13	31	252								296	3
6	8	21	167	17			83				296	5
7		15	120	12	30		60	60			296	6
8		15	120	12	30		60	60			296	6
9			126	13	31		63	63			296	5
10			95	10	24	72	48	48			296	6
11			95	10	24	72	48	48			296	6
12			95	10	24	72	48	48			296	6
13			95	10	24	72	48	48			296	6
14			95	10	24	72	48	48			296	6
15			95	10	24	72	48	48			296	6
16			104	10		78	52	52			296	5
17			104	10		78	52	52			296	5
18			104	10		78	52	52			296	5
19			104	10		78	52	52			296	5
20			104	10		78	52	52			296	5
21			104	10		78	52	52			296	5
22			104	10		78	52	52			296	5
23			104	10		78	52	52			296	5
24			104	10		78	52	52			296	5
25			104	10		78	52	52			296	5
26			104	10		78	52	52			296	5
27			104	10		78	52	52			296	5
28			104	10		78	52	52			296	5
29			104	10		78	52	52			296	5
30			104	10		78	52	52			296	5
31			104	10		78	52	52			296	5
32			104	10		78	52	52			296	5
33			104	10		78	52	52			296	5
34			104	10		78	52	52			296	5
35			104	10		78	52	52			296	5
36			104	10		78	52	52			296	5
37			108			81	54	54			296	4
38			108			81	54	54			296	4
39			108			81	54	54			296	4
40			103			77	51	51	13		296	5
41			120			90	60		15	12	296	5
42			120			90	60		15	12	296	5
43			120			90	60		15	12	296	5
44			120			90	60		15	12	296	5
45			120			90	60		15	12	296	5
46			120			90	60		15	12	296	5
47			120			90	60		15	12	296	5
48			120			90	60		15	12	296	5
Total	143	388	5676	329	235	3102	2334	1772	132	96	14208	

ANNEXURE B

HSE Displays

A. Types of Displays

1. Based on Content

SN	Type
1.	**HSE Hazards & Precautions** Height Work, Housekeeping, Fire Safety, PPEs, Hot Work, Lifting & Rigging Activity, Site-specific Hazards – eg. for Refineries, Nuclear plants etc.; COVID Precautions; Environment Protection etc.
2.	**Other Displays, Signage etc.** HSE Policy, ISO Certificate, Safety Statistics, Assembly Area Location/ Route, Emergency Contact Numbers, Site Safety Rules & Regulations, Speed Limit, Work in Progress, Lock-Out Tag-Out (LOTO) Boards etc.

2. Based on Mounting

[Type 1]	[Type 2]	[Type 3]
Flex Sign Boards of Wooden Frame – directly mounted on Structures (walls, stairs, railings etc.)	Flex Sign Boards with Wooden Frame – mounted on metallic/ wooden legs – preferably double-sided	Coloured weather-proof Paintings on Walls (after due concurrence of BHEL/ Customer – Type 1 in case of no concurrence/ space)

B. General Requirements:

a. Displays should be weather-proof as per installation location, i.e. rain-proof, wind-proof and sun-proof.
b. Installation location and size to ensure visibility for the intended viewers (workers and moving personnel)
c. Displays to have at least 50% graphical elements preferably (as applicable). Language should be understandable by majority of the workers
d. Displays to be relevant to the hazards in the area
e. Proper installation to ensure boards don't obstruct activities and should not be prone to fall so as to pose danger
f. In case of multiple elevations (eg. Boiler, Power-house etc.), each elevation to have displays for applicable hazards including Height-Work, Housekeeping
g. For temporary work locations, posters/ boards may be erected and shifted after task is over
h. Minimum size of displays should be A1 unless otherwise specified
i. In case of damage, displays shall be reviewed and repaired/ replaced
j. In areas where night work is envisaged, fluorescent displays shall be installed and these should comprise of at least 20-30% of total displays
k. Total Number of displays to be not less than 1 per 10 workers and are to be dynamically updated based on number of workers

C. Area-wise Displays

Below is list of Area-wise displays that are to be installed at Sites (Numbers, locations may be adjusted for specific requirements)

SN	Area	Suggested Subjects	Minimum Size	Minimum Quantity	Locations
1	**Walls/ Foundations/ Cement Structures etc. belonging to the package area**	Safety Hazards Prevention and other HSE Awareness content	**[Type 3]**	As per BHEL assessment from time to time	
2	**Site Interior Roads belonging to the package area**	At least every 20 meters: 1. Speed Limit Indication, Safe Driving board 2. Boards for hazard awareness	1.As needed **[Type 2]** **2.** A1 or equivalent each [**Type 2]**	As indicated	Sides of Roads; Height to ensure good visibility
3	**Specific Package Areas**	**A. Common** At entry to respective Package/ Work Area, each contractor to put up daily updated board with following for each shift: 1. Scope of work and start date 2. Emergency Contact Numbers 3. Emergency Assembly Location, Escape Plan 4. Locations and supervisors of various gangs in the area, 5. Current Work permit Details 6. Safety Supervisor Location assignments - Names, Mobile Nos., Assigned Locations 7. Details (Name, Contact No. etc.) of Package In-charge - Contractor & BHEL 8. Details (Name, Contact No. etc.) of Safety In-charge - Contractor & BHEL 9. LTI Free Man-days & details of last LTI also to be indicated In addition, Area-Specific Displays as indicated in Table 1	**A0** **[Type 2]**	1 per Package Area	Entry/ Ground Level

Table 1

(Area/ Package-wise HSE Display Plan – As applicable)

Prepared By (Subcontractor)				
S. No.	**Area**	**Suggested Minimum No. of Displays & Types**	**Type**	**Numbers Installed**
1	Boiler	3 per working elevation	**[Type 1]**	
2	Powerhouse	5 per elevation	**[Type 1]**	
3	ESP	5 Per Pass	**[Type 1]**	
4	Buildings	5 per elevation	**[Type 1]**	
5	Cooling Tower (NDCT/ IDCT/ ACC)	20 per Structure	**[Type 1]**	
6	Chimney	20 per Structure	**[Type 1]**	
7	Fabrication Yard	10 per Yard	**[Type 2]**	
8	Batching Plant	5 per Plant	**[Type 1]**	
9	Material Storage Yard – Open	20 per Yard	**[Type 2]**	
10	Material Storage Shed – Semi-Closed/ Closed	10 per Shed	**[Type 1]**	
11	Electrical Booths	2 per booth + Line diagram, Emergency contact details	**[Type 1]**	
12	Medical & First Aid Centre	2 per Centre	**[Type 1]**	
13	Rest Shed	2 per Shed	**[Type 1]**	
14	Canteen	2 per Canteen	**[Type 1]**	
15	Drinking Water Area	1 Per Outlet	**[Type 1]**	
16	Washing Water Area	1 Per Outlet	**[Type 1]**	
17	Training Centre	10 per room	**[Type 1/2]**	
18	Assembly Area	5	**[Type 1/2]**	
19	Stairs	1 per landing elevation	**[Type 1]**	
20	Cylinder Storage Area	5 + Signage: Type of Gas, Empty, Filled etc.	**[Type 1/2]**	
21	Labor Colony	Electrical Safety with Distribution Plan/ Line Diagram - 1 COVID Precautions Posters – 5 Safety Awareness Posters – 10 Hygiene awareness posters - 2	**[Type 1]**	
22	Others	As per requirement	**[Type 1/2]**	

Date:

Sign (Contractor) **Sign (BHEL)**

ANNEXURE C

HSE Tools/ Equipment/ Devices

Following equipment conforming to relevant IS/ISO/BS Codes/ Standards in indicated quantities shall be ensured by subcontractor. This list is tentative, not exhaustive. Quantity and date/ period of deployment shall be as per site requirement.

A. HSE Tools/ Equipment/ Devices

SN	Item
1	Lifelines
2	Retractable Fall Arrestors
3	Safety Nets (10m X 5m) fire proof double mesh
4	Sky Climbers
5	Fire Blanket
6	Honey Bee Removal Suit & Kit
7	Scaffolding Pipes
8	Flashback Arrestors
9	Barricading Tape
10	Binoculars
11	Walkie-Talkies
12	LOTO kit
13	24-Volt light
14	Sand Buckets
15	Hard barricading Pipes
16	Standby Fire kits
17	Hand-held Megaphone
18	Small Public Address System
19	Foldable Stretcher
20	Height Rescue Kit (Non-Motorized)
	(Others:)

B. Test & Measurement Devices

SN	Device
1	ELCB Tester
2	Multi meter (Light cables)
3	Earth Resistance Meter
4	Lux Meter
5	Sound Meter
6	Anemometer
7	Breath Analyzer (Alcohol)
8	Multi-gas dozi-meter/ detector
9	Gas leakage detector / alarm
10	Gas monitor (confined space)
11	Radiation meter & Badges
12	Blood Pressure Monitor
13	Fire detectors
14	Hand held signaling light
	(Others:)

ANNEXURE D

Rest Sheds

1. Determining the Number, Sizes and Locations of Rest Shelters

i. **Numbers:**

The number of rest shelters shall be determined based on maximum number of workers at any one time (across all shifts). Formula is:

Wmax = Maximum number of workers at any time in the Site

Space per worker = 1.1 sq meter

Total space required, Tspace = Wmax X 1.1

Based on total space requirement calculated above, the number of rest sheds can be decided according to availability of locations and concentration of workers – so as to ensure the required space.

ii. **Locations:**

The rest sheds should be so located so as to minimize the distance to be travelled by the workers from their locations of work considering all the practical constraints

iii. **Other:**

The Rest shelter should be fenced so that it cannot be used as parking area.

2. Design & Construction of Rest Sheds

a. Permanent/ Long duration Rest Sheds

i. For locations where, permanent rest sheds can be constructed without possibility of removal for relatively long period of time, a semi-closed shed can be constructed covered with tin roof and supported with well-grouted beams. The floor of the shed to be preferably cemented/ solidified.

ii. Adequate structural requirements suitable to the local weather (wind/ rain etc.) to be ensured.

iii. The design of the rest shed to be approved by Civil Engineering Department of BHEL Site before commencing work

b. Temporary/ Movable/ Portable Rest Sheds

i. For locations where, permanent rest sheds cannot be constructed either due to non-availability of permanent location or other reasons, temporary rest shed shall be constructed.

ii. Temporary rest sheds shall comprise of Tent arrangement carried out by professional agencies

3. Amenities in Rest Sheds

a. Essential Amenities

Following amenities shall be essentially ensured in a rest shed:

i. Hygienic environment with regular cleaning and housekeeping (with records)
ii. Adequate illumination
iii. Adequate ventilation/ heating as per weather conditions
iv. Clean Drinking water source
v. Hand Washing area
vi. Toilets & Urinals
vii. Benches/ mats for sitting/ lying
viii. Any other essential requirement deemed necessary by the Site
ix. Dust bins of sufficient quantity/ size that are vacated each day/ as per requirement

b. Additional/ Optional Amenities

Following amenities are optional but are recommended to enhance the level of satisfaction of work force:

i. Hot/ Cold drinks (Tea, Coffee, Glucose etc.) as per requirement
ii. Snacks
iii. Fans/ Coolers/ Heating arrangements as per requirement and weather conditions
iv. A nice, welcoming interior design, music etc.
v. Water cooler

4. Health & Safety Requirements of Rest Sheds

Use of asbestos in construction is banned and shall not be used.
In addition, following essential Safety features shall be ensured in Rest sheds:

i. Availability of Fire extinguishers (preferably CO2 type)
ii. Display of Safety Posters
iii. Pest/ reptile protection
iv. Mosquito prevention measures

5. Note:

Any suitable closed spaces/ newly constructed buildings etc. available at project may also be used for the purpose of rest shed with due concurrence of BHEL

ANNEXURE E

Labor Colony

1. These Guidelines suggest minimum requirements. However, additional requirements based on feasibility and circumstances, while adhering to directions of GOI/District Administration/Local Authority guidelines to be considered
2. Norms for social distancing, training/ awareness, face masks, disinfection, sanitization, gate entry, quarantine, medical, action in case of suspect cases of COVID and other communicable diseases etc. to be followed as per Govt. and BHEL guidelines issued from time to time
3. Labor colony to be developed as close to the Site as possible to avoid lengthy commute
4. A "Suggestion Register" shall be made available at the labor colony for residents. The feedback shall be reviewed on weekly basis and acted upon by concerned Contractor. Same shall be reviewed periodically by authorized BHEL Site Official.
5. **Canteens, Latrines & Urinals, Washing Facilities, Creches, Residential Accommodation and other infrastructure/ facilities:**
   Numbers/ Quantities and Features of these facilities shall be in line with the following as applicable:

   a. BOCW Act & State Rules
   b. The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act & State Rules
   c. Factories Act & State Rules
   d. Other Relevant Acts & Rules

6. **Cleanliness & Hygiene/ Housekeeping:**
   a. Regular cleaning of the labor colony to be ensured.
   b. Daily cleaning of Sanitary facilities.
   c. Proper drainage system to prevent water-logging
   d. Regular fogging to prevent spread of mosquitoes
   e. Prevention of foul smell through necessary interventions
   f. Dust suppression as per requirement
   g. Cutting of Grass at regular intervals and other necessary measures to prevent pests & reptiles
   h. Stray animals to be banned from labor colony.
   i. Outside every common facility, eg. Toilet, washroom, food hall/ canteen etc., provision of washbasin with flowing water and soap (preferably liquid soap) to be ensured
7. **Power Supply Layout:**
   Electrical supply Layout of Labor Colony shall have the provision of Safety devices like MCBs, ELCBs etc. and to be clearly displayed
8. **Washing & Drinking Water Availability**
   a. Adequate water to be provided in line with: "Estimation of Water Requirements for Drinking and Domestic Use (Source: National Building Code 2016, BIS)"
   b. Drinking water tank to be cleaned every week and sticker for the same pasted on the tank
   c. Drinking water source should be tested as per IS 10500
9. **Waste Disposal:** Separate bins for dry, wet and biomedical waste to be installed. These bins to be evacuated regularly
10. **Training & Awareness/ Displays**
    a. **HSE Awareness Displays**: Posters/ banners/ boards to be displayed in labor colony. Subjects of displays shall be precautions for applicable hazards at work site.
    b. **Emergency Contact Numbers** including that of Doctor, Hospital, Labor Colony Supervisor, HSE Officials to be displayed prominently

11. **Doctor Visits:**
    Regular and need-based visits by Doctors to be ensured through tie-ups etc.
12. **Inspection & Review:** Regular inspection of labor accommodation to be carried out by the Contractor as per prescribed format. Last inspection date, inspector and next due date to be prominently indicated near main gate
13. Provision of a Fair Price shop in the premises to be ensured as per requirement
14. Adequate arrangements to be ensured in case of children/ families

ANNEXURE F

Toilets

Toilets (Latrines and urinals shall be ensured at Site and Labor Colony in accordance with the Inter-State Migrant Workmen Act, 1979 as given below:

LATRINES	URINALS
1. Latrines shall be provided in every establishment on the following scale, namely: - a. Where females are employed, there shall be at least one latrine for every 25 females; b. Where males are employed, there shall be at least one latrine for every 25 males: Provided that where the number of males or females exceeds 190, it shall be sufficient if there is one latrine for 25 males or females, as the case may be, up to the first 100, and one for every 30 thereafter 2. Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.	1. There shall be at least one urinal for male workers up to fifty and one for female up to fifty employed at a time: Provided that where the number of male or female workmen, as the case may be, exceeds 500 it shall be sufficient if there is one urinal for every fifty females up to the first 500 and one for every 100 or part thereof thereafter. 2. The urinals shall be designed and located so as to ensure privacy.

Important:

1. Where workers of both sexes are employed there shall be displayed outside each block of latrine and urinal a notice in the language understood by the majority of the workers 'For Men Only', or For Women Ónly', as the case may be.
2. The notice shall also bear the figure of a man or of a woman, as the case may be.
3. The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
4. The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
5. Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the public health authorities.
6. Water shall be provided by the means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.
7. At Site, on ground, Modular Bio-toilets as per industry standard specifications and regular professional cleaning shall be ensured. The toilets should be sufficient in number and easily accessible to workers from every work area
8. At Site, in various elevations, suitable urinals with proper drainage to be ensured at each elevation in line with IS 2064 (1993). Same to be cleaned regularly

ANNEXURE G

Fire Extinguishers

SN	Type of Fire Risk (Class of Fire)	Extinguishing Medium & Relevant INDIAN STANDARD	Scale of Equipment (Minimum recommended)
1.	**CLASS 'A'** Fires involving ordinary combustible materials like wood, paper, textiles, rubber etc. (Ordinary hazard or low fire load)	WATER Soda acid type, water type (gas pressure) and water type (constant air pressure) IS: 934 -1976; IS: 940 -1976; IS: 6234 -1971	For every 600 square meter floor area or part, one 9-litre capacity. Minimum 4 numbers per floor or room; should not be required to travel more than 15 meter to reach any extinguisher.
2.	**CLASS 'A'** (Extra hazard &high fire load)	-do	-do – (Also, consult local fire authority).
3.	**CLASS 'A'** (Special hazards)	-do	-do – Extra provision For every 100 square meter floor area or part, one 4.5 Kg. CO2; minimum 2 numbers per room; should not be required to travel more than 10 meter to reach any extinguisher.
4.	**CLASS 'B'** (Fires in flammable liquids like oils, solvents, petroleum, products, varnishes, paints, etc. where blanketing effect is essential) (Storage and handling in small quantities)	FOAM / CARBON DIOXIDE / DRY CHEMICAL POWDER IS: 933 -1976; IS: 2878 1976; IS: 2171 1976; IS: 4308 -1982	For every 50 square meter floor area or part, 2 numbers 9 -liters foam or 5 kg dry powder; should not be required to travel more than 10 m in the area of storage to reach any extinguisher.
5.	**CLASS 'B'** (Bulk storage other than in tank form))	-do -	-do- (but minimum 3 numbers per room)
6.	**CLASS 'C'** (Fires involving gaseous substances under pressure where it is necessary to dilute the burning gas at a very fast rate with an inert gas or powder) (storage and handling of gas cylinders)	CARBON DIOXIDE / DRY CHEM. POWDER. The best way to extinguish such fire is by stopping the flow of fuel gas to the fire. Container is kept cool with water spray. IS: 2878 1976; IS: 2171 -1976; IS: 4308 -1982	For every 100 square meter floor area or part; 2 numbers, 10 kg powder extinguisher or 6 kg C02; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
7.	**CLASS'D'** Fires involving metals like magnesium, aluminum, zinc, potassium etc. where the burning metal is reactive to water and which require special extinguishing media or technique	SPECIAL DAY POWDER IS: 2171 -1976 IS: 4861 -1968	For every 50 square meter floor area or part, 2 nos. 5 kg special dry powder; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
8.	**MIXED OCCUPANCY** (electrical); Generators; Transformers; etc.	CARBON DIOXIDE DRY POWDER, IS: 2878 1976; IS: 2171 -1976	For every 100 square meter floor area or part one 10 kg C02. Minimum 2 numbers for every location should not be required to travel more than 10 meter to reach an extinguisher.
Note: Due to peculiarities of the power plant construction sites, there would be locations in the construction areas of Boiler, Turbine, Generator, Transformer, etc. where different types of fire risk (classes of fire) may co-exist. Special care shall be taken while selecting and installing portable fire extinguishers for such locations so that all types of fire risk that may co-exist, are adequately covered. Similar special care shall be taken for storage areas.			

a. All Electrical welding booths shall be equipped with appropriate Fire Extinguisher

b. Appropriate Fire Extinguishers shall be made within easy reach of all welding operations
c. Fire extinguishers shall be regularly tested and last checked date to be indicated on each. Master list shall be prepared with location and details
d. Providing appropriate fire-fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
e. Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times.
f. The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
g. All other fire safety measures as laid down in the “codes for fire safety at construction site” issued by safety coordinator of BHEL shall be followed.
h. Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
i. Emergency contacts nos. must be displayed at prominent locations
j. Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

ANNEXURE H

HSE Compliance Certificate

Bill Ref no:_____Date:_____

NAME OF THE AGENCY: _____ Work-Area/Package:_____

Sl. No.	Description	Remarks
1	**HOUSE KEEPING**:	
1.1	All working areas at site (specific to the agency) are free from garbage's, scraps & any other undesired non-plant materials. There is no encroachment in safe passage of man, material & T&P to carry out activities safely	
1.2	All the plant materials under the custody of the agency are stacked & stored properly.	
2	**GENERAL ILLUMINATION**:	
2.1	ALL the working areas at site & office of the agency including passages are having proper & sufficient illumination.	
3	**STATUTORY & REGULATORY REQUIREMENT**:	
3.1	Sufficient water for drinking & other purposes and sanitation in work area and labour colony are available.	
3.2	Periodical Medical check-up of workers & staff done regularly & report submitted to BHEL	
3.3	Regular EYE testing is done for Crane operators/Welders and data's are available with agency	
3.4	All the T&P, Cranes etc used by the agency are having proper T.Cs & Fitness certificate available from competent authority.	
4	**SAFETY COMPLIANCE:**	
4.1	Number of Tool box meetings between Safety officers, erection staff & workers of the agency held in this month with location mentioned	
4.2	All precautions & Safety measures including PPE compliances are taken before working at HEIGHT	
4.3	Permit for working at Height is taken & complied accordingly	
4.4	ELCB is used in Construction Power Supply source by the agency & Proper Distribution board and electrical cabling has been used by the agency and regularly checked by electrician & safety officer of the agency	
4.5	Unsafe areas barricaded properly &unsafe opening closed properly	
4.6	Proper Platforms & Hand-rails used In areas earmarked earlier	
4.7	Proper safety signage's, Slogans & Emergency contact phone numbers including FIRE contact nos. are made available by the agency in locations mentioned	
5	Whether any penalty imposed by BHEL towards non-compliance of above points.	

VENDOR'S SIGNATURE	
Erection Engineer	
HSE Officer	
Site-in-Charge	

BHEL'S SIGNATURE	
Erection Engineer	
HSE Officer	
Package-in-Charge	

ANNEXURE I

Activity-Specific Safety Precautions/ Controls

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General

The philosophy of hierarchy of controls as below shall be followed

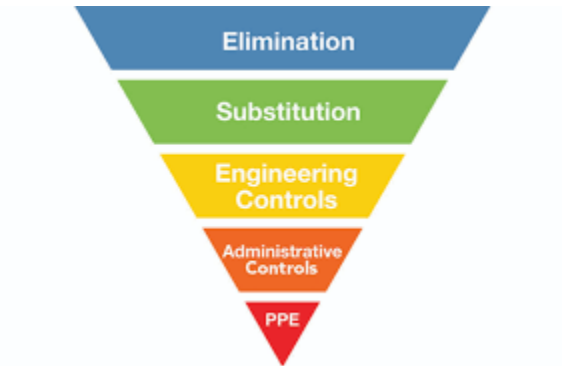


Fig. 1.1

It shall be ensured that there are multiple protections against any accident/ incident. For example, for height work there shall be safe platforms and walkways, Safety Nets and Lifelines for hooking double lanyard Safety harness by workers.

Monitoring and modifying worker behavior shall be part of ensuring safety. All personnel should be competent and trained for the job

Brief Safety guidelines for various hazardous activities are indicated below, besides the mandatory requirements based on Hazard Identification studies, HSE Procedures, Operational Control Procedures, Work Permits, applicable Indian Standard Codes and other provisions detailed in this document. Constant supervision at all times to be maintained by Execution & Safety Team to ensure implementation of these provisions.

1. WORK AT HEIGHT:

a. All work at height above 2 meter above ground level without complete platforms, handrails and other related fall protection shall require a work permit in the prescribed form. This shall require approval by the competent authority. The HSE officer of sub-contractors shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.

b. Prior to the start of work at elevation, the HSE Officer involved with the work must meet the work supervisor to review the scope of work, and must review all the possible fall hazards and effective safety responses. The evaluation / analysis must be documented and kept on file and on site by the HSE Officer.

c. Whenever a fall hazard or other exposure exists for working at heights more than 2.0m/6ft, the nature and scope of work will be evaluated for conditions and environmental factors before selecting the appropriate fall protection system (active, passive or a combination of measures, as appropriate).

d. All Engineering and Administrative Controls including barricading, safe platform, Safety Nets etc. shall be made available at work location. Under no circumstances, there shall be total reliance on PPEs only

e. **Safety Nets**

   i. Contractor shall maintain sufficient stock of Safety Nets for deployment

   ii. Safety Nets as per IS: 11057:1984 should be used extensively for prevention / arrest men and materials falling from height.

   iii. The safety nets shall be fire resistant, duly tested and shall be of ISI marked.

iv. Safety Nets shall be deployed below all platforms where height work is envisaged. Duration of work, delay shall be no excuses for non-installation of Safety Net

f. Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
g. Monkey Ladder shall be fitted with cages. Rope ladder should be discouraged.
h. In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
i. In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
j. For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor.
k. The procedures for the safety response to identified fall hazards developed and rescue plans must be reviewed with all individuals exposed to the hazards.
l. The HSE Officer must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. Such equipment must have evidence of the inspection and re-certification process on it. This information must be reviewed before the equipment is actually used. Individuals must visually inspect the fall protection equipment before each use. Failure to complete this inspection process could result in serious injury or death.
m. Immediately remove from service any fall protection equipment that is identified as defective, damaged, or has been subjected to an impact. Damaged fall protective equipment must be destroyed to prevent re-use and not be discarded into trash containers, as the worn or damaged equipment could be unintentionally re-used.
n. Aerial lifting devices, excluding scissor lifts require the use of full body harnesses and lanyards in any elevated position.
o. Where Height related works are applicable then rescue team (consist of 5- 10 person) shall be identified and trained for potential rescue.

1.1 Personnel fall protection system must include:

a. Safety Harness

All height workers must use Full Body Safety harness with double lanyards with shock absorber (only). The primary lanyard is never unhooked until the secondary lanyard is secure. The design of the working platform should be such that under no circumstances, worker should have both lanyards unhooked while at height.

b. Lanyard

i. The type of work and the environment conditions determine lanyard and lifeline selection. If welding, chemical cleaning that may damage lanyards, connectors or lifelines, sandblasting, etc., either protect the components or use more appropriate type of system.
ii. Lanyards and lifelines must incorporate, or be used with, an appropriate deceleration (shock absorbing) device. Deceleration devices include rope grabs, rip-stitch lanyards, specially woven lanyards, tearing, or deforming lanyards, automatic self-retracting lifelines and lanyards which dissipate or limit the energy imposed on the employee during fall arrest.
iii. Once in use, the system's effectiveness is to be monitored. In some cases, a program for cleaning and maintaining the system may be necessary. Lanyard and lifelines must use locking snap hooks only and under

no circumstances must two lanyard snap hooks be connected.

c. Lifeline

All lifelines in general are to be made of min 12mm dia. steel rope (plastic coated) and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts as per the design below are to be provided after carrying out drop load test initially. A load of 240kg to be dropped off the mid-point of lifeline in this test.

d. Lifeline Post

DIAGRAM : LIFELINE POST

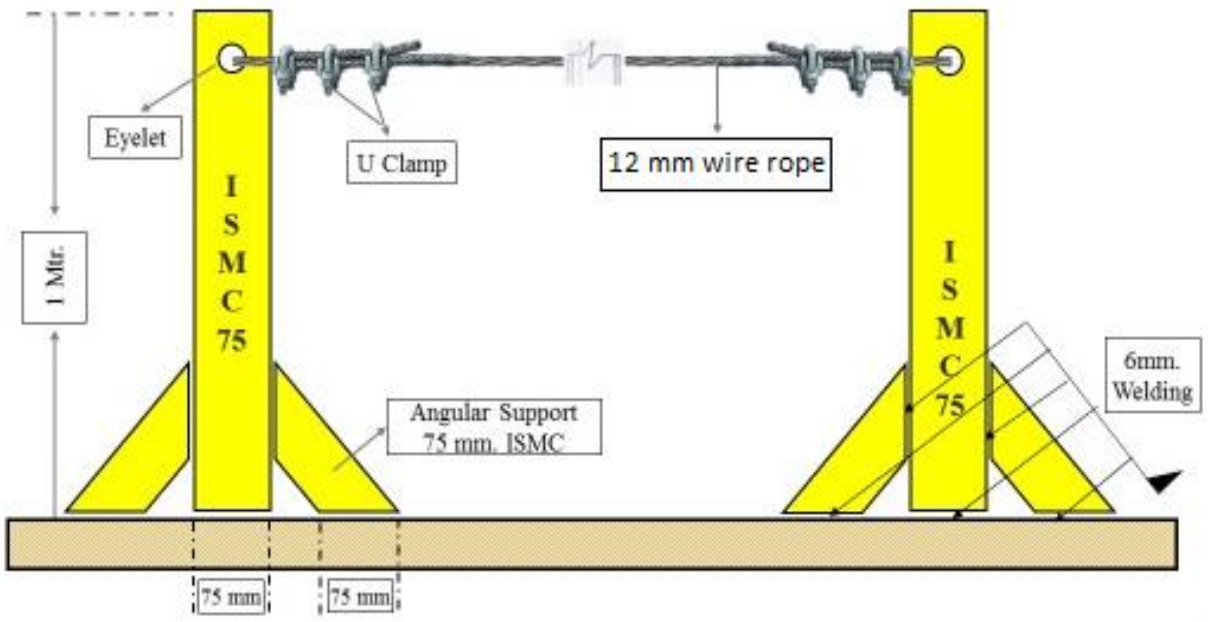


Fig. 2.1 Lifeline Post

i. The support at vertical post shall be fixed at end-to-end (welded/ bolted). The maximum length of one end to another end shall be 6 meters

ii. If the length of a lifeline is more than 6 meters, then intermediate vertical post(s) are to be used. Such intermediate post(s) will act as supports and the lifeline rope should simply pass through the eyelets (holes) of such supports without being anchored

iii. The lifeline need not be wrapped / clamped to any intermediate post

iv. Such intermediate posts must be used at an interval of every 6 meters

v. The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs.

vi. In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm

vii. For a single spun lifeline, no more than 3(Three Nos.) persons are allowed to work; for more than two workers, another lifeline should be installed

viii. Horizontal lifeline should be so installed that it does not impede safe movement of workers

ix. All the installation work must be carried out by competent person with adequate knowledge

1.2 Working Platform

a. Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or

floor level, they shall be closely boarded and shall have adequate width, which shall not be less than 750 mm and be suitably fenced.

b. <u>Precautions against the fall of Materials, Persons and Collapse of Structures:</u>

i. Every opening in the floor or a building or in a working platform shall be suitably barricaded to prevent the fall of persons by providing suitable fencing or railing whose minimum height shall be 90 cm.

ii. Adequate precautions should be taken such as the provision of fencing, or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered. Hard barricading shall be made at such places made of scaffolding pipe & clamps covered with reflective net. Cradle may be used for lifting materials - however this shall be made of MS angles and flats only and duly certified by the HSE officer. Operators may also use designed containers for lifting small tools.

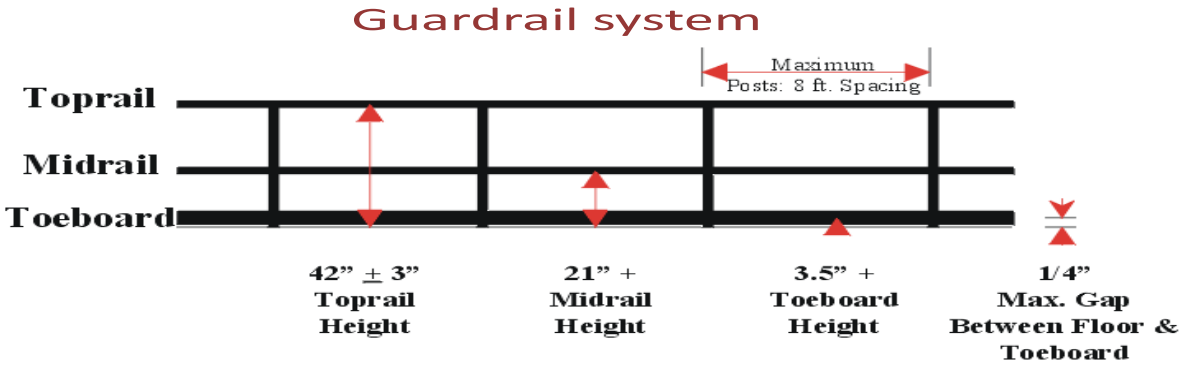
iii. Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outside the platform/decking.

iv. Guardrails must be able to withstand a 200-pound force exerted in any one direction.

v. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.

vi. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.

vii. Guardrails and toe-board/barricades and sound platform conforming to IS: 4912-1978 and other Indian laws and regulations as depicted below should be provided.



<u>Fig. 2.2 Guard Rail System</u>

viii. Guardrails shall be provided to protect workers from falling from elevated work places. The rails are generally made of MS pipes of suitable dia. Rebar shall not be used for any handrails, ladder or cover purpose. Wherever the guard-rails and toe-boards cannot be provided:

a. adequate safety nets or safety sheets shall be erected and maintained; or
b. adequate safety harnesses shall be provided and used and / or
c. adequate fall arrestor shall be provided and used.

As mentioned under PPE clause, all these PPEs shall be defect free and regularly inspected for any defect. The full body safety harness shall have double lanyard only with max 1.8m length.

ix. The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire rope shall be provided across the work area.

x. The HSE officer shall recommend appropriate PPEs after analyzing hazards and risks involved.

1.3 Scaffolding

All scaffolds shall be conformant to the relevant standards including IS 3696 and IS 4014 as applicable. A sketch of the scaffolds proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use. Only cup lock type scaffoldings will be allowed in site. Where cup lock type scaffolding arrangement is not feasible by the virtue of the location, in that case only pipe and clamp type scaffolding will be allowed.

a. The scaffolding work must be carried out by a competent person, who shall train the scaffold users on safety aspects
b. All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of competent scaffolding supervisors.
c. All scaffolds shall be capable of supporting 4 times maximum intended load and erected on sound, rigid footing, capable of carrying the maximum intended load without settling or displacement. Bamboo scaffolding is not permitted for use on site.
d. Each employee on the scaffold shall use an approved safety harness attached to an independent lifeline. The lifeline is to be securely attached to substantial members of the structure (not the scaffold itself) or to securely rigged lines, which shall safely suspend a worker in event of a fall.
e. Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor
f. Scaffold planks must be at least 5 cm x 25 cm (2” x 10”) full thickness lumber scaffold grade or better.
g. Scaffold planks shall not span distances greater than 2.5 meters (8 feet).
h. Scaffold planks shall extend over end supports not less than 6 inches nor more than 12 inches and be secured to the scaffold. Scaffolding and accessories with defective parts shall be immediately repaired or replaced.
i. All scaffolding must be a minimum of two planks wide. No one may work from a single plank.
j. Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
k. Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
l. Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
m. Scaffolds more the 6 meters (20 feet) in height must be tied to the building or structure at intervals which do not exceed 4 meters (13 feet) vertically and 6 meters (20 feet) horizontally.
n. Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in excess of its rated capacity.
o. Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
p. Where persons must work under or pass under a scaffold then a 18 gauge wire mesh screen must be installed between the toe board and guard rail.
q. Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2”) thick planks.
r. Wooden/bamboo ladders shall not be allowed at any cost. Ladder’s rungs shall be fitted /welded

properly. Before every use the rungs should be checked for safe use.

s. Wooden scaffolds shall not be used in areas where fire / fire products are expected

t. Ropes made of jute / Plastic and other fire prone material shall not be used to tie up scaffolding components together

u. The platform should have permanent hand rail and mid rail with Toe board without fail.

v. All platforms are to be tightly planked for the full width of the scaffold, except as may be necessary for entrance openings. Platforms shall be secured in place.

w. On suspension scaffolds designed for a working load of 500 pounds, no more than two workers are permitted to work on the scaffold simultaneously. On suspension scaffolds with a working load of 750 pounds, no more than three workers are permitted on the scaffold simultaneously.

x. Requirements for different types of Scaffolds:

A. Suspended Scaffold

i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.

ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

B. Rolling Scaffolds

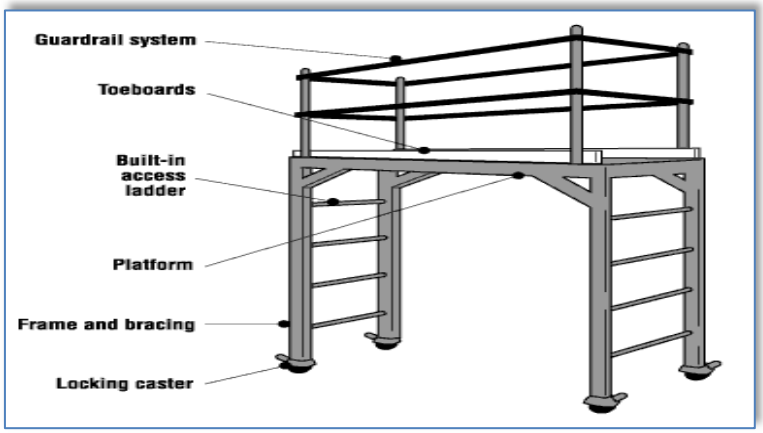
i. The height of rolling scaffolds shall not exceed three times the minimum base dimension.

ii. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).

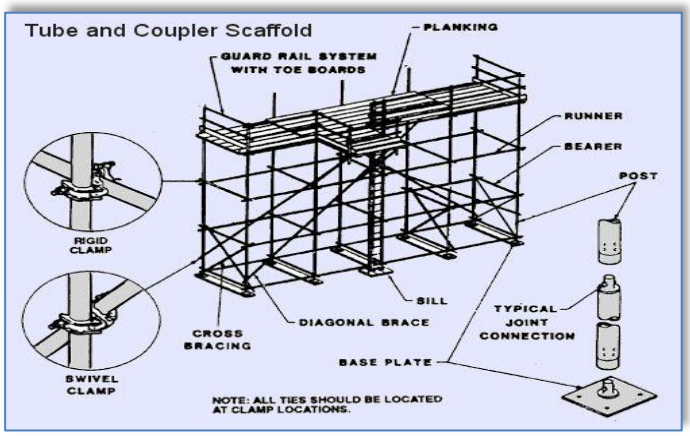
iii. Adequate help must be provided when moving a rolling scaffold.

iv. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.

v. No one is permitted to ride a rolling scaffold when it is being moved. Castor brakes must be locked-on when the scaffold is not being moved.



Rolling Scaffold



Tube & Coupler Scaffold

Fig. 2.3 Types of Scaffolds

1.4 Ladder Safety

A sketch of the ladders proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use

a. Safe Use of Ladders:

i. Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.

ii. Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
iii. Use portable ladders for height up to 4 M only
iv. Provide fixed ladders for height above 4 M
v. Place the ladder at an angle of 75 degrees (approx.) from the horizontal (1:4)
vi. Extend ladder at least 1 M above the top landing
vii. Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
viii. Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
ix. Provide landings of minimum size 600 x 600 mm at intervals not more than 6 M for fixed ladders. Check the ladders daily for any defects
x. Ensure that the areas around base and top of the ladder are clear. Getting on and off the ladder is more hazardous than using it. Use a mudsill if the ladder is to rest on soft, lose or rough soil
xi. Do not use ladders of conducting material near power lines, and only use ladders near power line or other energize system with exposed parts if they are confirmed locked-out and de-energized.
xii. Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
xiii. Never reach out from a ladder to perform work where your belt buckle protrudes past the ladder rung.
xiv. Always face the ladder while climbing up or down
xv. Maintain three-point contact while climbing up or down a ladder i.e. two hands and one foot or two feet and one hand on the ladder at all the times.
xvi. Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
xvii. Work from portable and extension ladders near guardrail where fall expose exists over the guardrail regardless of height, and above 2.0 mtr. heights from the working/walking surface will require the use of personal fall arrest equipment

2. EXCAVATION & CIVIL WORKS

All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

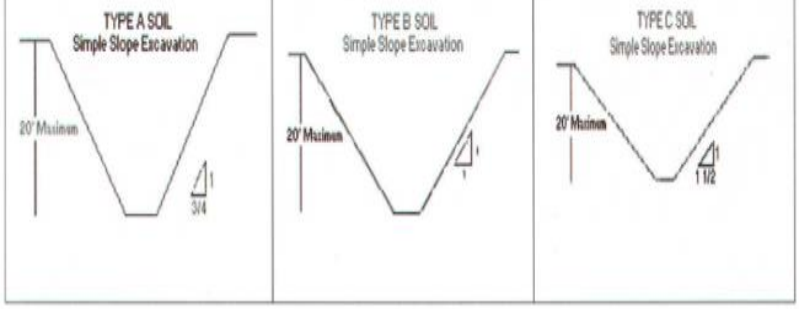
2.1 Excavation

The following safety measures are to be ensured before and during excavation:

a. All Excavation activities more than with depth of 1.22 meter or more shall require and Excavation Work Permit
b. Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage to it.
c. Electrical cables and service lines to be identified using cable detector/locator device before carrying out the excavation work
d. Proper and adequate slope is maintained while excavating
e. Adequate shoring or sheeting is done wherever require to prevent soil sliding
f. Safe access through ladder or steps for exit & entry to excavation
g. No material /excavated soil is kept within one meter from the edge
h. Safe way is planned and provided for movement of HEM /transport equipment near excavation
i. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works

j. Dewatering arrangement is made where water seepage is prevailed.
k. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
l. Danger signs /Caution boards are displayed at work spot
m. Hard Barricading is provided at excavated pits. It should be made of scaffolding pipe and clamp with reflective nets.
n. All Excavated area of depth 3mtr or more is to be hard barricaded with pipe.

Soil Type	Height/Depth ratio	Slope Angle
Stable Rock	Vertical	90 deg.
Type A	¾ : 1	53 deg.
Type B	1 : 1	45 deg.
Type C	1½ : 1	34 deg.



Determining Soil Type

Type	Description	Examples
A	Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot or greater.	Clay, silty clay, sandy clay, clay loam and in some cases: silty clay loam and sandy clay loam.
B	Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.	Angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam.
C	Cohesive soils with unconfined compressive strength greater than 0.5 tsf or less.	Granular soils such as gravel, sand and loamy sand; submerged soil or soil from which water is freely seeping; submerged rock that is not stable.

Fig. 3.1 Excavation Reference

2.2 Piling

Ensure the following precautionary measures before starting piling works:

a. Inspection of piling equipment by responsible person for its condition before initiating piling operation.
b. Checklist and OCP for piling to be prepared using manufacturer's instructions and used
c. Testing and its certification wire rope, slings, D-shackles, chain pulley blocks using in the process of piling work by competent person
d. Adequate support and secured foundation of the piling equipment to avoid toppling
e. Hoses should be lashed and adequately secured
f. Proper work platform is to be provided on piling frame
g. Safe work procedures and close supervision to prevent unsafe acts of operators/any unsafe conditions that may arise
h. Only experienced and trained operators are engaged for the piling operation
i. Provision of Personal Protective Equipment (PPE) like safety shoes/gumshoes/safety helmet/safety belt etc. and its use by their workmen.
j. Special care and precautions If work is near electrical live cables/ electrical equipment
k. Cordoning of work area to prevent un authorized entry
l. Guarding of revolving parts
m. Specific measures to prevent over turning of pile driver/missing of hammer/ hammer movement out of range

2.3 Batching Plant Operation

Following Safety considerations for batching plant are to be ensured:

1. Modern type batching plant should be used in which all the moving parts are protected and emergency

and safety features are incorporated.

2. Installation of external Electric moto-vibrators in the feeding hopper of all batching plants to reduce human intervention.
3. Installation of safety devices like pull-chord on both the sides of conveyor for stopping the conveyor in emergency
4. Workers carrying cement / sand to be given appropriate PPEs like respiratory masks & gloves.
5. Conveyor belt/rotating parts must be guarded properly.
6. Safety awareness shall be inculcated in workmen about the risk involved in rotating parts.
7. The agency shall ensure to erect the batching plant as per drawing including installation of all safety devices as provided by manufacturer and witnessed by BHEL Engineer in charge before starting of machine in future.
8. Safety audit to also focus on Batching plant.
9. The site shall impose penalty on the agency who has violated the safety norms as per contract.

2.4 Mobile Plant

Mobile plant includes tractors, trailers, dumpers, excavators, bulldozers, road rollers etc. for earthmoving purpose and concrete mixers, concrete transit mixtures, concrete pumps etc for concreting purpose. Due to the very nature of their function and movement in difficult terrains, congested areas, working in tandem with manual work and other operations the danger is inherent.

Automatic reverse camera with reverse horn connected with reverse gear is compulsory for all moving machineries.

Following Safety measures to be ensured for Mobile Plant:

a. Where movement around site is involved, routes should be planned, obstruction free and well maintained
b. Observe specified speed limits
c. Operating personnel should be aware of associated risks and its preventive measures
d. Only experienced, trained and authorized persons with valid license (wherever applicable) should operate the mobile equipment/vehicles
e. Provide and use Warning lights and reverse horn for cautioning the people around
f. Operation should be on level and stable ground with adequate working clearance.
g. Loading of out riggers/stabilizers should be well within safe ground bearing capacity
h. No person should be on equipment or vehicle during loading and unloading of material
i. Operators should be protected by warning barriers or switching off power when working in close proximity of overhead power lines
j. The equipment /vehicles should be well maintained and provided with effective brake system and other safety devices (wherever require)
k. Rotating parts of equipment should be adequately guarded
l. Provide necessary personal protective appliances and ensure its use by the operating personnel Ensure effective measures at source to control harmful emissions, dust, fumes contaminating atmosphere and cause health hazards to the operators and people in the vicinity.
m. No overloading/over stressing of vehicles/plant is allowed
n. Hoses, pipes, receivers, gauges and valves involved in carrying out hydraulic fluid/ compressed air should be checked for leaks and tested prior to operation.

o. Adequate safe clearance for swing and movement is to be judged during operation of Concrete mixer
p. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
q. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket
r. Operator leaving work spot should ensure that the equipment/vehicle is kept in neutral position and place on firm and level ground.
s. The hand brake should be kept in position and block road wheels as additional safety measure
t. Blades/buckets should be kept low while moving
u. The dozer blades should not be used as brakes except in emergency
v. The ground should be examined for its bearing capacity and general safety especially when operating road roller at the edges of slopes, embankments.
w. The roller should not be moved downhill with the engine out of gear
x. If operating near excavations the following precautionary measures are to be ensured
y. Barricading, edge protection to prevent fall of persons/vehicles over running while reversing etc.
z. Suitable support system and adequate allowance to avoid the danger of side collapsing
aa. Experienced signaler /attendant should be always accompanied with operator/driver for proper direction /signal and also to caution others in the working Zone during operation of mobile plant

2.5 Concrete Vibrators

a. Revolving parts/belt drives should be adequately guarded and Vibrating unit shall be completely enclosed and have suitable overload relays and effectively earthed
b. Ensure sufficient length of cable to the Vibrator.
c. Ensure electric starters and other accessories are firmly fixed adequately supported
d. Ensure locking of needle load while inserting needle in to the vibrator,
e. Ensure periodical lubrication and maintenance

2.6 Concrete Mixers

a. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
b. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

3. WELDING & GAS CUTTING SAFETY (HOT WORK)

a. All Hot Work shall require a Hot Work Permit
b. Inbuilt Voltage Reduction Device (VRD) equipped arc welding machine will only be allowed for work.
c. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced.
d. All safety precautions shall be taken for welding and cutting operations as per IS-818.
e. When possible, items to be welded, cut, heated, etc. shall be moved to a safe location free of combustible or flammable material. If this is not possible, then all combustibles/ flammables that can be removed from the area shall be removed within a 35-foot circumference and a positive means of confining arcs and sparks generated by the process shall be ensured and additional person(s) shall be stationed as fire-watch for the area(s) still exposed, along with obtaining the Hot Work Permit as applicable.
f. Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times suitable for the type of Fire.

g. Drums, tanks, and similar containers that have contained flammable or toxic material shall not be welded, cut, or heated until they have been made safe by water filling, thorough cleansing or similar accepted practices. The container shall also be ventilated during the welding, cutting, or heating process.
h. Proper ventilation is required for any welding or torch operations performed in a confined space.
i. Any welding or gas cutting operations performed on metals of toxic compounds or coating such as zinc, stainless steel, lead, cadmium, chromium, and beryllium shall be properly ventilated and/or proper respiratory protection shall be worn by any person that could be exposed to fumes, vapors, and gasses created by the welding and gas cutting processes.
j. Wherever it is practical, all arc welding operations shall be shielded to prevent direct light rays or sparks from contacting persons in the vicinity or from reaching areas normally used to travel through or into the vicinity. Where this is not practical, persons who shall be in the area are to use proper eye and skin protection. Other persons who are not participating in the welding or gas cutting operations are not to be allowed into the hazard zone.
k. Welders and other employees who are exposed to arc welding radiation shall wear suitable clothing and protective apparel to prevent burns and other types of ultraviolet radiation damage to the skin.
l. Arc welding machines shall be shut down when being moved or when they are not in continuous use. Electrode holders left unattended shall have electrodes removed and shall not be left where they might contact employees or conducting objects.
m. Arc welding power supply cable shall be of proper rating and material, e.g. copper.
n. Welders shall guard against allowing materials adjacent to or behind them to reflect radiation back toward them or towards others in the area. Reflected radiation can cause skin burns and eye flash burns.
o. Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
p. Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot-work.
q. Splatter / Slag Collector:

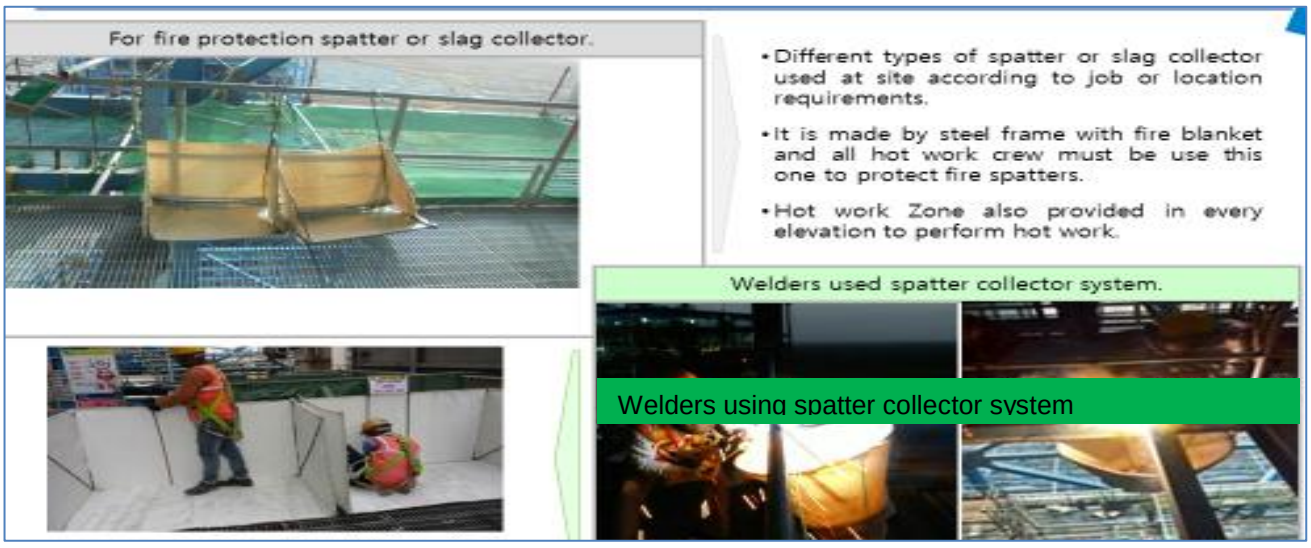


Fig. 4.1 Splatter / Slag Collector

While carrying out job at height, the sparks or molten slag shall be prevented from falling down by putting a fire-resistant (non-asbestos) sheet or patter/ slag collector or even MS Sheet. The passage of falling sparks

or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passages hall either be removed or covered with Fire-resistant sheet or MS Sheet.

r. COMPRESSED GAS

i. All cylinder valves shall be closed when any work is finished and when any Cylinders are empty or being moved. Valve protection caps shall be placed and secured properly before gas cylinders are transported, moved or stored.

ii. Compressed gas cylinders shall be secured in an upright position with chain or appropriate means during storage & use. However, a trolley shall be used for transportation.

iii. Compressed gas cylinders shall always be secured from tipping or falling, whether in use, in storage or in transit. The cylinders shall always be secured upright, except during times when actually being hoisted or carried.

iv. When cylinders are transported by powered vehicle they shall be secured in a vertical position.

v. Regulators shall be removed when cylinders are not in use or are in transit, unless the cylinder is firmly secured on a special carrier designed for this purpose.

vi. Gas cylinders are not allowed to be used in man-basket when occupied.

vii. Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.

viii. Oxygen cylinders shall be stored a minimum of 6 meters from fuel gas cylinders or shall have an approved firewall between them.

ix. All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from arc/ sparks / slag.

x. All cylinders shall be placed where they cannot become part of the electrical circuit.

xi. Oxygen and acetylene shall not be stored together. Oxygen must be separated from acetylene (or ANY fuel gas) or combustible material by at least 20ft or a barrier with a 30-minute fire resistance rating.

xii. All Cylinders should be stored upright in a designated area with labels for the type of gas. All applicable precautions to be ensured during storage

xiii. Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.

xiv. Compressed air can be extremely dangerous if allowed to penetrate the skin. As such, the use of compressed air to clean off yourself or other workers shall be strictly prohibited.

xv. All gas cylinders shall be stored in upright position. Suitable trolley shall be used for cylinder movement, the design of which shall be submitted to BHEL Engineer for approval.

xvi. No of cylinders shall not exceed the specified quantity as per OCP

xvii. Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

xviii. All cylinder should be kept only in cylinder trolley.

xix. Cylinder shall be transported in upright vertical position by suitable mean.

4. LIFTING & RIGGING SAFETY

a. All Heavy / Complex Lifting operations as defined in Clause 6.12 shall require a Lifting Work Permit. A written rigging procedure and plan must be prepared for all individual heavy/ complex lifting operations.

b. All the cranes and lifting tools & tackles shall be inspected on daily / weekly basis as well as monthly by expert as per applicable formats.
c. In addition, inspection / certification as mandated by law shall be carried out wherein these shall be tested and certificates of fitness shall be obtained from 3rd party State Govt. approved competent agency before deploying at site and later periodically. BHEL shall be given advance intimation of any such inspections
d. The last date of Third-Party Inspection and the next Due date shall be conspicuously displayed on all cranes. A copy of certificate shall be pasted on operator's cabin of all the lifting equipment.
e. Specifically designed heavy steel plates lifting clamps shall be used for lifting heavy metal sheets. Manmade lifting clamp chapa shall not be used for lifting/shifting of plates.
f. Following requirements shall be mandatorily followed, wherever applicable:
    i. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
    ii. All tools tackles, lifting appliances; material-handling equipment etc. used by the subcontractor shall be of safe design and construction.
    iii. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
    iv. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over load chart of the crane to be avoided.
    v. Mobile phone should be banned for crane operator and lifting operation. Only walkie talkie shall be allowed in rigging/Lifting purpose.
g. Lifts/Movements between 5 Tons and 20 Tons:
    i. Shall include a rigging plan, detailing schematic representation of the handling/lifting operations that must be included on the Method Statement.
    ii. When performing similar lifts of identical items, only one rigging plan need be prepared, provided each of the lifts can be performed in accordance with the rigging plan.
h. Lifts/Movements Less Than 5 Tons:
    i. An equipment rigging plan is not required for lifts less than 5 tons, safety measures are covered in the JSA. This could change as per BHEL requirement

i. Personnel Lifts (Man-Basket / Jhoola):

The design of personnel man basket shall be submitted to BHEL Engineer for approval before use. Relevant permit (Height work & others as applicable) shall be completed prior to lifting any people, along with a rigging plan.

i. A separate Lifeline / fall arrestor anchored to a fixed structure outside of Jhoola shall be provided for the workers inside the basket. All occupants of the basket shall have Safety Harnesses equipped with rope grabs, which are to be hooked to the vertical lifeline.
ii. Man-basket shall be used where access through ladders or scaffolding is not feasible.
iii. Man-baskets shall be designed and engineered by a manufacturer (job made man-baskets are not allowed, unless designed and tested by a certified engineer), and built robust with MS Angles and flats or plates or channels only.
iv. Guard rails top and mid, must be in place and screened-in to avoid material from falling out of

basket. The factor of safety shall be 200%.

v. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.

vi. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.

vii. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and inspection as other lifting equipment.

viii. An additional sling of required lifting capacity shall be fixed the man-basket main lifting point and attached to the crane above the ball or block.

ix. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.

x. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket
   a. remains at that point. The same care shall be taken in its descent.

xi. As for hanging man-basket, the same shall be hung off a rigid structure with help U-shaped handle welded to man-basket. This shall be tested once in a year by a competent person.

xii. Use of Rebar steel for making and monkey-ladder must be avoided.

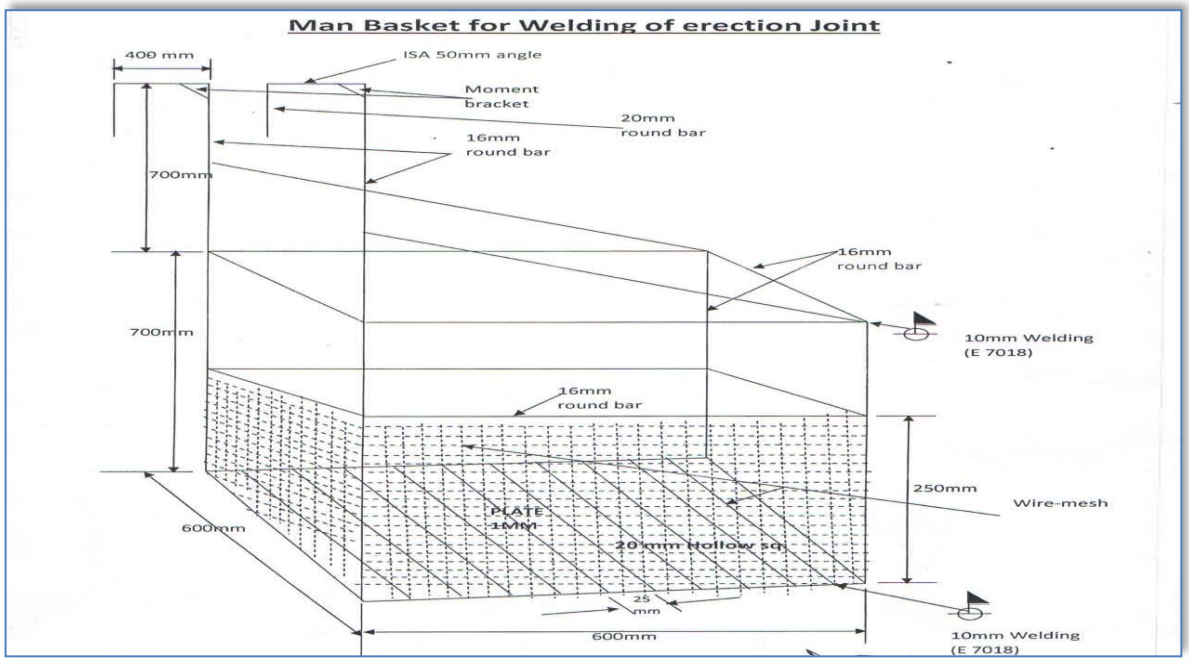


Fig. 5.1 Man Basket for Welding Erection Joint

4.1 Cranes & Hoisting Equipment:

This section provides the guidelines to ensure proper rigging and lifting activities are accomplished safely and in accordance with applicable specifications, codes, and regulations.

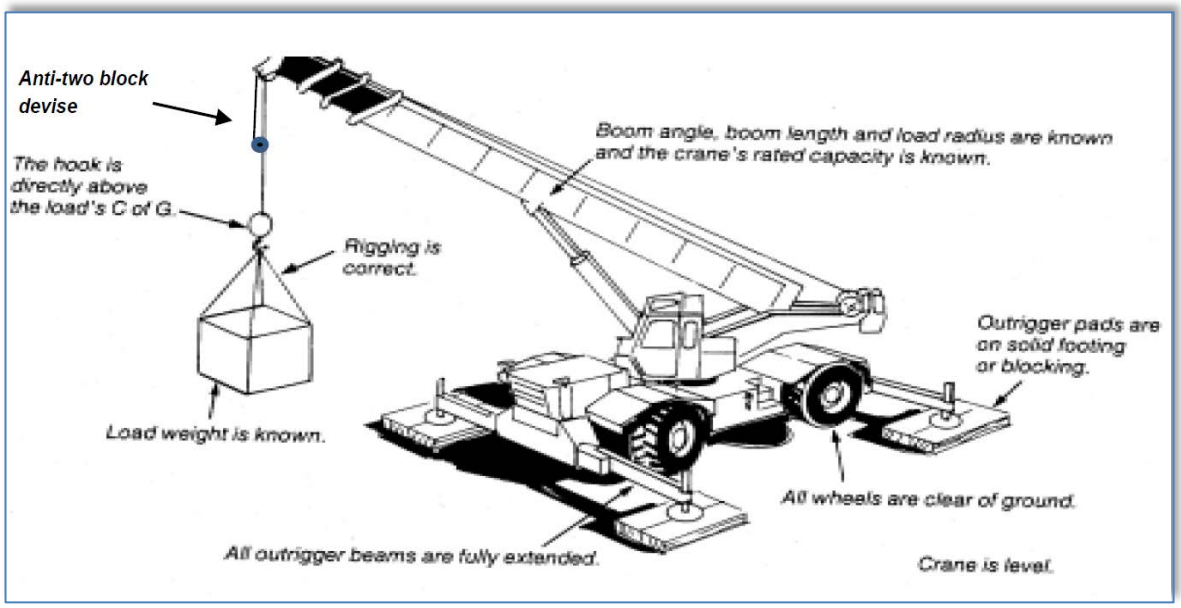


Fig. 5.2 Proper Crane Setup

a. On every crane or piece of hoisting equipment notices of all rated load capacities, recommended operating speeds, and any hazard warnings or special instructions shall be conspicuously posted. All instructions and warning shall be visible from the equipment operator ‘s station.
b. Cranes shall have an Anti-Two-block safety device installed
c. All mobile cranes shall have overload and backup alarms, load angle indicators and limit switches
d. All areas within swing radius of cranes that are potentially accessible by pedestrian, vehicular, or equipment movement shall be barricaded to prevent anyone or any vehicle or equipment from being struck by the crane or hoisting equipment, or its load(s).
e. No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energized power line
f. Cranes shall have annual certified third-party inspection and be inspected before use by the operator. Any defects shall be corrected before use. Logs of crane inspection shall be kept with the crane.
g. Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.
h. Communicate with person(s) directly responsible for accomplishing the work and / or work area to establish requirements/responsibilities and make certain that all preparatory work is complete.
i. Mats/Pads must be used on all lifting equipment, equipped with out riggers.
j. Pick and carry must have the load secured to the rig in front.
k. Only BHEL Approved Plate Lifting Spreader Beam configuration shall be used (Sample in Fig. 11.3.5.3)
l. <u>Crane operators must follow the following:</u>
    i. Pass an annual Operator’s Physical examination
    ii. Carry a valid training certification card at all time while operating issued by the Govt. or other recognized institute.

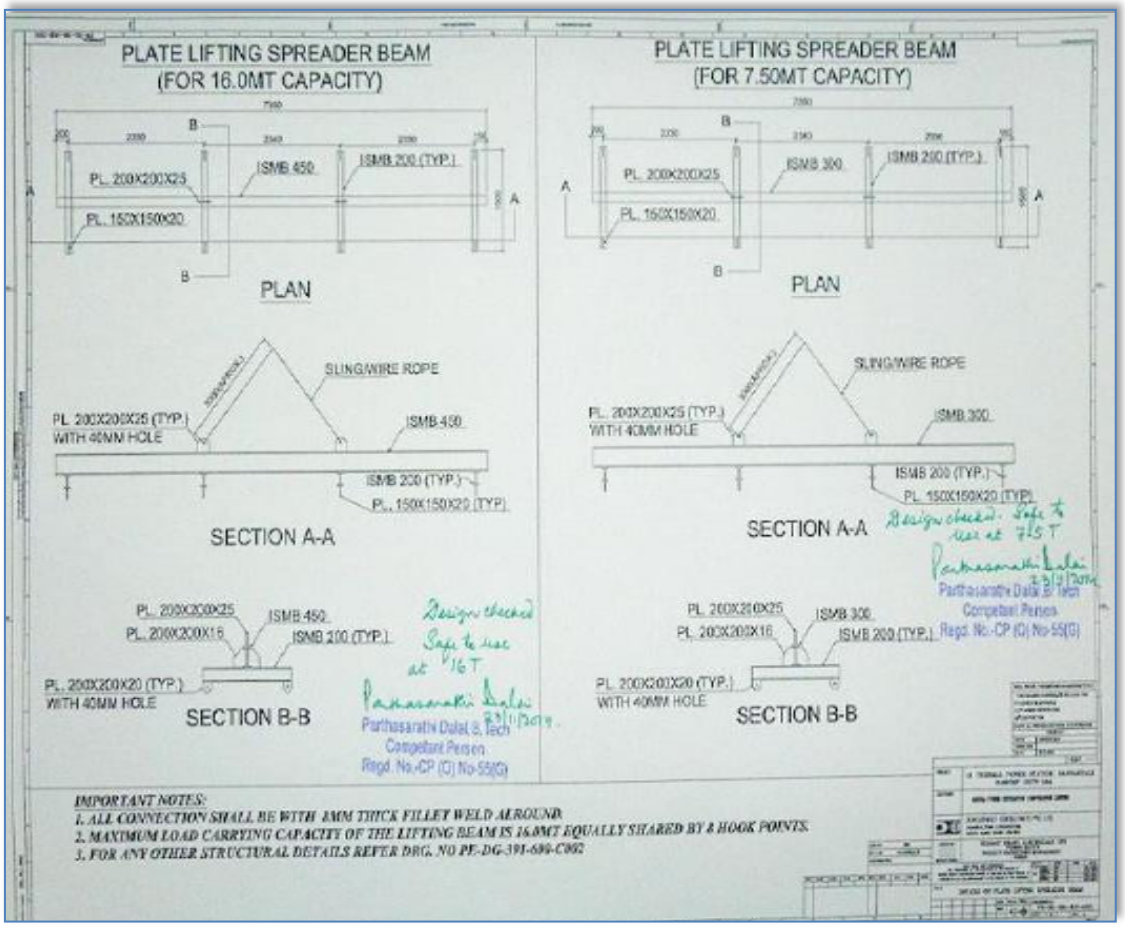


Fig. 5.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads

m. Safe Rigging Practices

i. Review the planned operation and requirements with the operator and rigging crew.
ii. Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
iii. Designate a qualified person from the rigging crew to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desire clearance by visual means.
iv. Clear the lift area of all unnecessary personnel.
v. Hydras shall only be allowed for loading & unloading works & shall not be allowed to move with load

n. Rules for Safe Rigging

i. Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
ii. Never allow wire rope to lie on the ground for any length of time or on rusty steel or near solvents, chemicals or corrosive substances.
iii. Slings must not be pulled from between or under loads with load resting on the sling.
iv. Keep all rope away from flame cutting or welding operations.
v. Never use rope as sling material.
vi. Never wrap a wire rope completely around a hook.

vii. Do not bend wire rope near any attached fitting.

viii. The sling must be selected to suite the most heavily loaded leg rather than the total weight when using multi-legged sling to lift loads in which one end is heavier than the other.

ix. When using 3 and 4-legged sling configurations, any two legs must be capable of supporting the entire load.

x. Where possible, wire rope choker hitches must include a shackle with the eye around the shackle pin to prevent breaking wires of the choke. The choker hitch must be “snugged down” prior to lifting, not after tension is applied.

xi. Unless authorized by the hook manufacturer when more than two rope eyes are placed over a hook, install a shackle, pin resting in the hook, and place the rope eyes in the bowl of the shackle.

xii. Properly rig all loads to prevent dislodgment of any part.

xiii. Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.

xiv. Loads must be safely landed and properly blocked before being unhooked and unslung. Tag lines must not be used in situations that jeopardize the safety of the lift.

xv. Lifting beams must be plainly marked with their weight and designed working load and must only be used in the manner for which they were designed.

xvi. The hoist rope or chain must never be wrapped around the load. The load must be attached to the hook by slings or other rigging devices that are adequate for the load being lifted.

xvii. Multiple part lines must not be twisted around each other.

xviii. The hook must be brought over the center of gravity of load before the lift is started.

xix. If there has been a slack rope condition, determine that the rope is properly seated on the drum and in the sheaves prior to lifting.

xx. Keep hands away from pinch points as the slack is being taken up.

xxi. Leather gloves are recommended when handling wire rope.

xxii. Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.

xxiii. Never ride on a load that is suspended.

xxiv. Avoid allowing the load to be carried over the heads of any personnel.

xxv. Never work under a suspended load until the load has been adequately supported from the floor and all conditions have been approved by the supervisor in charge of the operation.

xxvi. Never leave a load suspended unless emergency evacuation is required.

xxvii. Never make temporary repairs to sling.

xxviii. The capacity of a sling is determined by its angle, construction, type of hitch and size.

xxix. Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.

xxx. Never point load a hook unless it is especially designed and rated for such use.

xxxi. Make certain that the load is broken free before lifting and that all legs are taking the load.

xxxii. When using two or more slings on a load make certain all slings are made from the same materials.

xxxiii. Lower the loads on to adequate blocking to prevent damage to the slings.

xxxiv. Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.

xxxv. The weight of the hook, load block and any material handling devices must be included when determining crane capacity.

xxxvi. Calculated weights cannot exceed load chart without written approval.

xxxvii. Personnel must be completely clear of loads being picked up or set down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

o. Slings

The following are rules for safe use of synthetic slings:

i. Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.

ii. Nylon web slings must not be used where fumes, vapors, sprays or mists or liquids of acids or phenolic are present. Web slings with aluminum fittings must apply in this category.

iii. Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:

a. Acid or caustic burns
b. Melting or charring of any part of the sling surface
c. Snags, punctures, tears or cuts
d. Broken stitches
e. Distortion of fittings
f. Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
g. Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
h. Insulated hooks must be tested yearly to ensure insulation integrity to at least manufacturer's specifications.

p. Wire Rope Slings must be removed from service and destroyed if any of the following conditions are present:

i. In (10) randomly distributed wires broken in one (1) rope lay, or five (5) broken wires in one (1) strand in one (1) rope lay.
ii. Wear or scraping of one-third the original diameter of outside wires.
iii. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
iv. Evidence of heat damage.
v. End attachments that are cracked, deformed worn.
vi. Corrosion of the rope or end attachments.

q. Metal mesh slings must be immediately removed from service if any of the following conditions are present:

i. A broken weld or broken brazed joint along the sling edge.
ii. Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
iii. Lack of flexibility due to distortion or corrosion.

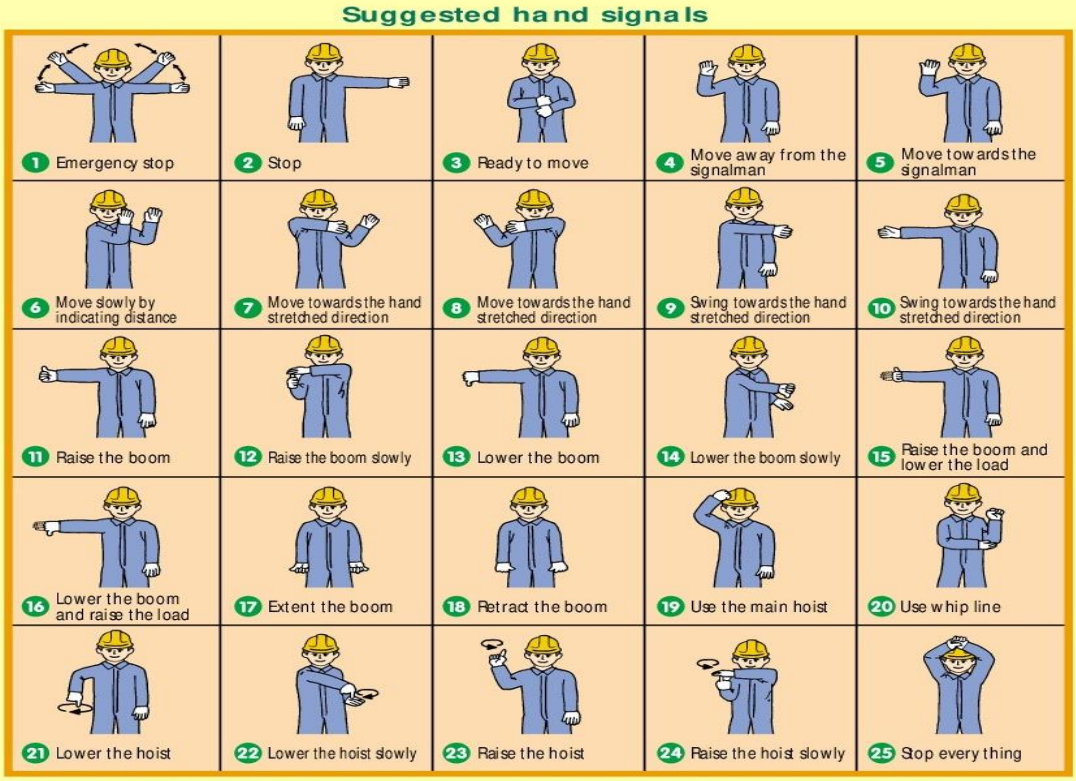
r. Requirements of Plate Clamps:

i. The rated load of the plate clamp must be marked on the main structure.

ii. Care must be taken to make certain the load is correctly distributed for the plate clamp being used.
iii. Do not allow load or plate clamp to come into contact with any obstruction.
iv. The plate clamp must not be used for side pulls or sliding the load.
v. When lifting stainless steel or special alloys, ensure plate clamp is designed for use on the specific metal.

s. Signaling Practices:

- The "slinger" is responsible for attaching and detaching the load to and from the crane. He shall:
  – have received appropriate training on general safe lifting operations;
  – be capable of selectings lifting gears suitable for the loads;
  – liaise with the operator and direct the movement of the crane safely.
- The "signaller" is responsible for relaying the signal from the slinger to the crane operator. He shall:
  – have received appropriate training on general safe lifting operations;
  – be able to direct the movement of the crane and loads.



Note: During the lifting operation, either the slinger or signaller shall communicate with the operator. Other communication methods (e.g., wireless walkie-talkies, telephones, etc.) may also be used.

Fig. 5.4 Recommended Signaling Practices

5. DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured, besides using the Work Permit:

a. All roads and open areas adjacent to the work site shall either be closed, suitably protected or restricted for movement
b. No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.

c. All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

6. T&PS GENERAL

a. All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test /calibration certificates bearing endorsement from competent authority of BHEL.
b. Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.
c. Tagging and punching in all lifting tool is compulsory with SWL, sr. no. and due date.
d. All T&Ps shall be inspected by authorized Third Party agency as per applicable frequency. BHEL shall be kept informed of any such scheduled inspection
e. All T&Ps shall be internally inspected in each quarter and colour coded.

7. CHEMICAL HANDLING

a. Displaying safe handling procedures & MSDS for all chemicals such as lube oil, acid, alkali, sealing compounds etc. at work place.
b. Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.
c. The used containers of chemicals shall be segregated and disposed of suitably
d. In case the used containers need to be re-used, all traces of the chemical to be removed by thorough cleaning with detergents etc. under trained supervision

8. ELECTRICAL SAFETY

a. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
b. No PDB or any other distribution board shall be more than 03 (three) years of purchase. Only modern PDB with industrial sockets as shown in layout below to be allowed to use at site.
c. Power supply to all equipment at site to be routed through MCBs of appropriate rating. A 'Power Supply Distribution Plan' shall be prepared and submitted to BHEL Engineer for approval
d. All power supplies through cables shall be underground or overhead with height > 3mtrs.
e. All power distribution boxes shall be locked and the key controlled by site management of concerned subcontractor.
f. All individual equipment & tools at site shall be powered through Earth Leakage Circuit Breakers of 30 mA sensitivity.
g. These MCBs and ELCBs shall be regularly tested as per Clause 14
h. All fuses and fuse wires shall be of standard size and rating.
i. All electrical appliances used in the work shall be in good working condition and shall be properly double earthed other that armour earthling.

j. All extension boards shall have separate switches for all sockets / connections.

k. All portable electric tools used by the subcontractor shall have safe plugging system (industrial top & socket) to source of power and be appropriately earthed.

l. Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts especially in confined spaces like inside water boxes, turbine casings, condensers etc.

m. Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)

n. Portable Electric Lights

i. Portable electric lights used in wet or potentially wet locations must be either low voltage type (24 volts or less) or protected by a GFI (ground fault interrupter).

ii. They must be visually checked before each use and periodically while in use to assure their original integrity is maintained.

iii. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately.

iv. Repairs to extension cords shall only be performed by qualified/ licensed electricians.

v. Must not be allowed to lie in wet or potentially wet areas.

o. Underground Cables:

i. Every electric line or cable of unknown origin that is discovered or exposed during a digging, drilling, probing, or similar operation is to be considered as energized and life threatening.

ii. The senior company employee on the site will ensure that all necessary safety precautions are taken in order to isolate the line from all workers and the public.

iii. Such precautions may include halting the operation if appropriate.

iv. The senior company employee on the site is to then contact the proper authorities to have the line identified and either confirmed to be abandoned and/or made safe for continuing the work.

v. Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.

p. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL

q. The subcontractor shall use only properly insulated and armoured cables and conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.

r. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the risk & cost of the subcontractor.

s. No maintenance work shall be carried out on live equipment

t. Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public

u. The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

v. Wiring and Branch Circuits Must be protected by a proper amperage over-current device such as a HRC fuse or circuit breaker. Such installations must be located so as to prevent physical damage to the wire conductors & panels.

w. The sub-contractor shall supply modern power distribution board of different combination (1-phase & 3-phase). All the distribution of power should be through modern PDB. Equipment drawing is mentioned below.

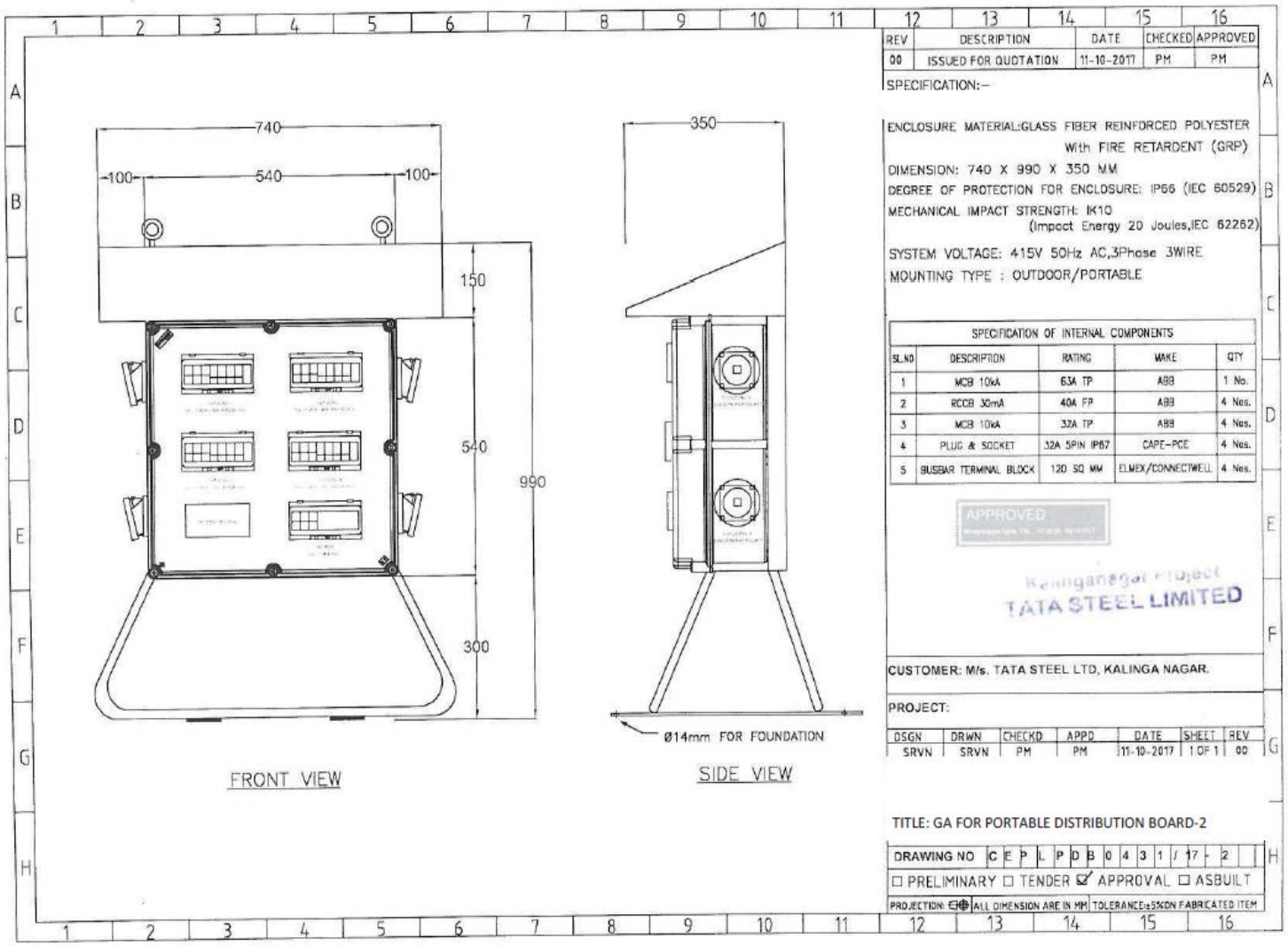


Fig. 9.1 Layout of a modern Power Distribution Board

x. General Electrical Safety

i. In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft. to all power lines.

ii. TAG IN/ TAG OUT must be in force in Switch Room and all Distribution Boxes for live power line. The authorized person's name and contact no shall be displayed

iii. Ensure "double insulated" three - core cables and three pin connectors are used and are properly ground "all insulated" types, all electrical tools and appliances must be manufactured for industrial use.

iv. All connections shall be electrically and mechanically sound and properly insulated. Taped joints are not permitted. Connections to socket outlets must be made with proper plugs (industrial top and socket).

v. Splices in electrical cords are not permitted. Repairs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.

vi. Damaged or defective electric tools, equipment and extension cords, etc. must not be used and shall be tagged out of service, removed from the work area and taken back to stores.

vii. Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.

viii. Temporary electric cabling should be elevated 2.2 meters above the floor/ground or covered for protection. It must be kept clear of walkways and other locations where it may be exposed to damage or create a tripping hazard.

ix. Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.

x. Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.

xi. Personnel should never work on energized equipment, de-energizing (lockout/tag out) the equipment is always the first requirement.

xii. The lockout and tag out procedure will be used when testing or working on, or around, energized installation.

xiii. Working around energized equipment should never be done alone. A second electrician must always be available for assistance.

xiv. If lockout/tag out of the work is infeasible (must be demonstrated), work on energized electrical circuits must be approved by the Site In-charge. All safety precautions necessary must be taken, PPE use must be evaluated per the exposure and used, i.e high/low voltage gloves, insulated shoes, overcoats/aprons, face shields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.

xv. The welding machines earth leads shall be properly fixed without loose contacts. The earth cable only has to be used. No steel members shall be used as earth leads.

xvi. Electrical crews must be qualified for the equipment and tools they work on, including being trained in Cardio-Pulmonary Resuscitation (CPR) methods and First Aid for rendering help in the event of electric shock.

y. Qualified Persons for Electrical Works

(One who is trained and wiremen licensed to Govt. of Respective State and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.)

i. Qualified persons are intended to be only those who are well acquainted/experienced with and thoroughly conversant in the electric equipment and electrical hazards involved with work being performed.

ii. Only qualified persons may be permitted to work on or near exposed energized parts. Such persons are required to have been trained in three specific areas:

iii. Qualified persons must be capable of working safely on energized circuits;

iv. Must be familiar with the proper use of special precautionary techniques and procedures bases on equipment and exposure; and

v. Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.

vi. Qualified persons are expected to be able to evaluate unknown situations and adjust their activities in such a way that only safe work practices are used. Such behavior is the responsibility of the qualified person.

vii. It is possible and likely for an individual to be 'qualified' with regard to certain equipment in the work place, and unqualified on other equipment they must know their limitation and stop work if not qualified on what equipment they were to work on.

viii. An employee who is undergoing on-the-job training, who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties. The process must be documented as proof.

z. Mandatory PPEs of electrical work on LV & HV

i. HV arc flash suit with protective hood (for protection of face and head) as specified for hazard risk category-4 in NFPA-70E or similar IS specification for working on HT switch gear (for all voltage >690 V) to the concerned licensed electrician or competent person.

ii. LV arc flash jacket/FR as specified for hazard risk category-4 in NFPA-70E or similar IS specification having ATPV rating of 8.5 to 9 cal/cm2 for working on LV (>260V and <=690V) to the concerned licensed electrician or competent person.



iii. The LV arc flash jacket as shown above shall be worn continuously while working on LV (>260V and <=690V). The color specification of LV arc flash jacket should be blue.

iv. Electrical hand gloves should have following specification: Flame resistance, arc flash and cut protection of voltage rating (>260V and <=690V).

v. Electrical safety over shoe of relevant IS make for foot protection of licensed electrician or competent person while working in HV & LV line or equipment.

9. USE OF HAND TOOLS AND POWER-OPERATED TOOLS

a. General Provisions

i. All hands and power tools and similar equipment, shall be maintained in safe condition.

ii. When power operated tools are designed to accommodate guards, they shall be equipped

iii. with such guards, when in use;

iv. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;

v. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;

vi. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive on-off control.

vii. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

b. Hand Tools

i. The subcontractor shall not issue or permit the use of unsafe hand tools;

ii. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;

iii. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;

iv. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

c. Power Operated Tools

i. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;

ii. The use of electric cords for hoisting or lowering loads shall not be permitted;

iii. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;

iv. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;

v. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm2 pressure at the tool a safety device on the muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;

vi. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm2 and that too with effective chip guarding. The 2 kg/cm2 pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;

vii. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;

viii. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;

ix. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;

x. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;

xi. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;

xii. Loaded tools shall not be left unattended;

xiii. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;

xiv. Driving into materials that can be easily penetrated shall be avoided unless backed by a
xv. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
xvi. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
xvii. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
xviii. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

d. Abrasive Wheels and Tools

i. All grinding wheel must be ISO certified only.
ii. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
iii. Grinding machines shall be equipped with suitable safety guards;
iv. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 900, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 1200. In either case, the exposure shall begin not more than 8.650 above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
v. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;
vi. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
vii. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of incidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 1800;
viii. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
ix. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of incidental breakage, shall be used;
x. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;
xi. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
xii. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

e. Wood Working Tools

i. All fixed power-driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position;
ii. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed,

the marking shall be corrected to show the new speed;

iii. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;

iv. All portable power-driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

10. START UP, COMMISSIONING AND TESTING:

There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Transformers Charging, Boiler Light Up, Rolling and Synchronisation and Full loading of unit.

a. These activities shall be personally supervised by the site executive along with the commissioning engineer.
b. Appropriate Work Permits shall be taken as applicable
c. The readiness of upstream and downstream system shall be ensured before taking up.
d. These shall be handled strictly by the authorized persons only and the team shall be suitably briefed about the activity including hazards & risks involved and control plan by the concerned executive-in-charge before start.
e. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid center and Fire station shall be intimated about the plan well in advance.
f. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
g. Electricians with valid wiremen license only shall be permitted to work on power lines.
h. The area and the passage shall be adequately illuminated.

11. FIRE SAFETY

a. The Fire Prevention, Protection and Preparedness Program is an integral part of the overall HSE Program. Effort and consideration must be given to safety, life and potential for delays in construction schedules and plant startup, as well as protection of property on a given project. The purpose of which is to prevent
    i. Inception of fire
    ii. Loss of life or personal injury
    iii. Loss of Property
    iv. Interruption of operations
b. Site-in-charge / Safety Officer will make periodical review of the site Fire Protection, Prevention Preparedness Programme, Site conditions and available fire protection equipment. It is very imperative that the Sub-contractors along with BHEL to establish good contact with Local fire station for availability of Fire tender in case of emergencies, in additional to their own fire equipment.
c. Fire Protection, Prevention and Preparedness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities.
   Deficiencies will be corrected at once.
d. Area where Hot work activities are carried out (Gas cutting / Welding/ any other spark producing work)

above a working spot, a GI / fire-resistant non-asbestos sheet or suitable material shall be placed to prevent the fall of hot sparks. A bucket of water shall be kept nearby while doing hot work

e. Hot work shall be preferably carried out in a designated area with a standing Hot Work Permit, to be renewed monthly. The designated area shall have fire extinguishers.

f. Any hot work outside designated area shall require a Hot Work permit and fire watch. No flammable material shall be stored within 35 feet from any fire load.

12. PAINTING:

a. Requirements provide a detailed procedure to be implemented by all concerned employees and sub-contractors involved in painting activities.

b. Significant Environmental Hazards:
   i. Chemical hazard due to inhalation of lead fumes (lead containing paint)
   ii. Chemical hazard due to inhalation of VOC's from paining operations
   iii. VOC's from painting and coating operation
   iv. Disposal of paints and coats drums

c. Control Procedure for Paining:
   i. Chemical products used in painting and coating operation shall have proper MSDS sheet in place. Whenever any doubt arises with respect to handling and safety point of view it should be accessed to all concerned.
   ii. Toxic substances and hazards relate the toxic chemicals shall be identified.
   iii. Proper PPE shall be used including plastic gloves appropriate overall etc.,
   iv. Arrangement for cleaning of spillage shall be ensured

d. Only trained workers shall be allowed and proper training should be imparted to the works.

e. Exposure limits of the toxic substances shall be checked before starting the work and nobody shall be allowed to carry the work beyond the permissible limit.

f. Ventilation or exhaust facility shall be provided at place where painting and coating operations are carried out.

g. Overalls shall be supplied by the contractors/subcontractors to the workmen and adequate facilities shall be provided to enable the painters to wash at the cessation of work.

h. Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored.

i. A caution board in national /regional language "**smoking strictly prohibited**" shall be displayed in the vicinity.

j. Suitable fire extinguishers/sand buckets shall be kept available at places where flammable paints are stored, handled or used.

k. In case of indoor painting or painting in confined spaces, exhaust ventilating shall be provided. If adequate ventilation is not provided a proper respirator shall be provided and used by persons who are trained and fit tested.

l. The VOC's from painting and coating operations shall not exceed the permissible level of CPCB/ SPCB norms. The paints and coats must be selected as per the guidelines.

m. Workers shall thoroughly wash their hands and feet before leaving the work.

13. "HAZARDOUS ENERGY" CONTROL PROCEDURE/ LOCKOUT/TAGOUT (LOTO)

Hazardous Energy Control Procedures, known as "Lockout/Tagout (LOTO)" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Contractors must develop and submit a written LOTO program This requires that a designated qualified individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock and tag the energy- isolating device(s) to prevent the release of hazardous energy and test the machine or equipment to verify that the energy has been isolated effectively.

a. Minimum Requirements:

The following are minimum requirements that must be included in the Contractor's LOTO program:

i. Inspection of equipment by a trained individual who is thoroughly familiar with the equipment operation and associated hazards.
ii. Identification and labeling of lockout devices. Purchase of locks, tags, and blocks Development of a standard written operating procedure, permitted through a controlling authority that is followed by all workers.

b. General Requirements

The following steps must be taken to protect workers that install or service equipment and systems:

Follow the hazardous energy procedures and statutory regulations. Follow the manufacturer's service/repair instructions. Identify and label all sources of hazardous energy. Before beginning work, accomplish the following:

i. De-energize all sources of hazardous energy:
ii. Disconnect or shut down engines or motors.
iii. De-energize electrical circuits.
iv. Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
v. Block or secure machine parts against motion.
vi. Block or dissipate stored energy.
vii. Discharge capacitors.
viii. Release or block springs that are under compression or tension.
ix. Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere

c. Lockout and tag out all forms of hazardous energy including electrical breaker panels, control valves, etc. Make sure that only one key exists for each of your assigned locks and that access to the key is controlled. Verify by test and/or observation that all energy sources are de- energized.

d. After completion of the work, accomplish the following:

i. Inspect repair work before removing the lock and activating the equipment.
ii. Make sure that only the worker that installed the lock removes his/her assigned lock.
iii. Make sure that all workers are clear of danger points before re-energizing the system.

e. LOTO Procedure

PURPOSE AND SUMMARY

This procedure provides the requirements and responsibilities of Hazardous Energy Control and the process for Lockout / Tag out (LOTO) of energy isolating devices (valves, circuit breakers, disconnect, etc.). Its use

shall ensure that machinery, equipment, or systems are isolated from all potentially hazardous energy to prevent unexpected energization, startup, or release of stored energy which may cause personnel injury or property damage.

This procedure applies to all BHEL personnel and subcontractors working on the WBPDCL (1X660MW) STAGE-III projects where equipment must be taken out of service for the performance of work activities such as installation, maintenance, repair, construction, or equipment removal. The procedure may also be used to isolate equipment of which the energization or operation may present danger to personnel or property.

Lockout / tag out are not required for electrical equipment that can be unplugged from the source and the person performing the work has control of the plug.

This procedure shall be applied to prevent injury or damage caused by the unexpected release of active or stored energy. Hazardous energy sources could be in the form of the following:

- Electrical
- Hydraulic
- Chemical
- Thermal
- Mechanical
- Pneumatic

Preplanning of work activities includes the identification of all potential hazardous energy sources so that they may be properly controlled and isolated, locked, and tagged out.

Prior to initiating work activities on or around locked out / tagged out equipment, the equipment must be tested and tried by or in the presence of the person(s) performing the work activities.

RESPONSIBILITIES

- The Engineers in Charge is responsible for implementing and enforcing this procedure and approving lockouts /tag outs that impact the operation of the project.
- The Engineer in Charges responsible for authorizing Lockout /Tag out Requests.
- The Lockout / Tag out Coordinator is responsible for maintaining the Lockout / Tag out Log. Each shift should have a designated Lockout / Tag out Coordinator.
- The Isolator is responsible for determining the proper isolation devices and device positions required to isolate all potential energy sources so that the work stated on the Lockout /Tag out Request Permit may be safely performed. The Isolator must be familiar with the equipment and energy type(s) that require isolation. For this reason, in some cases the Isolator may be more than one person (i.e. Engineer, System Operator and/or Electrician). The Isolator shall position the specified device points, and apply locks and tags, and sign the tags and the LOTO Permit isolation point blocks.
- The Safety Manager is responsible for conducting an annual audit that is documented to ensure all procedures and requirements are current and being followed as written.

DEFINITIONS

Affected Employee: -

An employee whose job requires him/her to operate or use machinery or equipment on which servicing or maintenance is being performed under a lock out/tag out procedure or whose job requires him/her to work in an area in which servicing or maintenance is being performed under a lockout/tag out procedure

Authorized Employee: -

An employee who implements a lockout/tag out procedure on machinery, equipment, or systems in order that servicing or maintenance may be performed. Often an authorized employee and an affected employee may be the same person.

Danger "Do Not Operate" Tag

A tag used to identify energy isolation devices and specify the required position of the device. The tag should be affixed to the isolation device such that it is in plain view of anyone attempting to operate the device. The tags shall be sequentially numbered and shall specify the lockout/ tag out request number. The tag shall also state the purpose, and the expected duration of the lockout /tag out

Isolation Device

A device that is designed and intended to prevent the passage of energy. These devices, usually located at the energy source, are typically valves, circuit breakers, etc. Isolation devices should have a means of being locked in position

Lockout Device

A device that uses a positive physical means such as a lock, either key or combination type to maintain an energy isolation device in the safe position and prevent the in advertent energization of machinery, equipment, or systems. Device locks should serve no other purpose other than hazardous energy control isolation

Lockout Tag out Request Permit

A pre-numbered form used to request that machinery, equipment or systems be taken out of service. A Lockout/Tagout Request Permit may be initiated by any one requiring energy isolation for work activities or for taking faulty equipment out of service

Lockout / Tag out Request Log

A record of all Lockout /Tag out Request Permits shall be maintained by the Lockout /Tag out Coordinator.

PROCEDURE

1. REQUESTING A LOCKOUT / TAGOUT PERMIT

When machinery, equipment, or systems are partially or completely taken out of service for work activities or equipment protection, a lockout / tag out shall be requested. The requestor shall be familiar with scope of work required and shall provide a brief description of the work on the Lockout / Tag out Request Permit. The requestor shall also provide the proposed start time and estimated duration of lockout / tag out. If familiar with the machinery, equipment, or system to be taken out of service, the requestor may identify the devices that are required to be isolated. The LOTO Request Permit shall be forwarded to the Authorized Lockout / Tag out Coordinator for reviewed and signature, along with Permit to Work number to be entered on the LOTO Request Permit.

a. The Lockout / Tag out Coordinator shall record the necessary information on the Lockout / Tag out Request Log and forward the request to the Engineer in Charge for approval.
b. The Safety Manager or Engineer in Charge shall review the Lockout / Tagout Request Permit for impact on project operations. Project operations could be impacted by the equipment being taken out of service or by the required isolation to take the equipment out of service. If project operations are impacted by the Lockout / Tagout, the request shall be forwarded to the Engineer in Charge for approval.
c. The Engineer in Charge shall provide the lockout / tag out isolation points necessary to perform the task stated on the request. The device identification, device location, device position, and locking mechanism

shall be entered into the appropriate blocks on the Lockout / Tag out Request Permit.

d. The Engineer in Charge indicates approval of the Lockout / Tagout Request Permit by signing in the appropriate space on the request. If the Lockout /Tag out Request Permit is rejected, the Engineer in Charge shall return it to the requestor, via the Lockout / Tagout Coordinator with a written explanation of the rejection.
e. Once approved, the Lockout / Tag out Request Permit shall be forwarded to the Lockout / Tag out Coordinator to assign tags and locks.
f. The log shall show current status of all Lockout / Tag out Request Permits from submittal to approval, through lifting of locks and tags to final closeout. The log shall be maintained by the Lockout / Tag out Coordinator in their office.

2. PLACEMENT OF LOCKS AND TAGS

a. The tags shall be filled out to match the information on the LOTO Request Permit. Appropriate locks for the types of isolation devices specified shall be collected and placed with the tags and the Lockout / Tag out Request Permit.
b. The isolator(s) shall take the device locks, tags, and the Lockout / Tagout Request Permit to position the specified isolation devices, sign and hang the tags, and place the locks. If the isolator does not agree with or understand the Lockout / Tagout Request Permit, or has a problem performing the isolation, the problem should be brought to the attention of the Safety Representative or Area Supervisor immediately and the lockout / tag out should be postponed until the situation is resolved.
c. Once the Isolator has placed all “locks” on isolation points, they will “test ”and “try” the machinery, equipment, or system to ensure all hazardous energy has been completely removed and the isolation is one totally accomplished, and has initialed and signed the Lockout /Tag out Request Permit indicating all isolation points have been confirmed. Examples of “lock”, “test” and “try”:
    - by checking that all locks on the LOTO Request Permit have been applied and are in the specified position open/closed, on/off, etc.; metering test of electrical circuits, opening of drain valves, checking pressure gauges or indicators; and try by pushing start buttons and on/off switches, etc.
    - Testing shall be performed by person(s) knowledgeable of the energy source(s) being isolated (e.g., an electrician should meter electrical circuits).
d. A copy of the completed Lockout /Tag out Request Permit shall remain with the Work Package and used as part of the daily Pre-Job Briefings

3. WORKING UNDER A LOCKOUT / TAGOUT REQUEST

a. Prior to starting the work activity, the person(s) performing the work shall review the Lockout / Tag out Request Permit and place the necessary tags and personal locks on the identified isolation devices. Personal locks may be placed only on devices that have already been locked and tagged in accordance with the Lockout / Tag out Request Permit.

- All personal locks shall be accompanied by a tag that is signed and dated by the worker(s) and specifies the work activity being performed.
- Personal locks should be of a different color than device locks for ready identification.

b. Verification of the effectiveness of the isolation by the Isolator shall be performed for Worker’s working under the lockout / tag out, by demonstrating the checks on “lock”, “test” and “try”,
c. When the work activity is finished, personal locks and tags shall be removed and the Safety Representative

shall be notified that the Lockout / Tagout is no longer required. If work under a lockout / tag out is to be delayed or interrupted for a period in excess of 24 hours, personal locks shall be removed until the work restarts. Personal locks shall be removed prior to the worker(s) leaving the project at the end of shift unless the key(s) are maintained at the project.

4. REMOVAL OF LOCKS AND TAGS

a. When the lockout / tag out is no longer required, the Safety Representative or Area Supervisor shall obtain the Lockout / Tagout Request Permit from the work package for LOTO removal. Prior to removing locks or tags that may allow equipment to be energized, a check shall be made to verify that the equipment is free to safely operate (i.e., will not cause damage or injury). The locks and tags shall be removed and returned to the Lockout / Tagout Coordinator. Isolation devices may be repositioned at the discretion of the Engineer in Charge according to operational requirements. The Isolator shall complete the Lockout / Tagout Request Permit indicating each lock and tag has been removed and the Safety Representative or Area Supervisor forward to the Lockout / Tagout Coordinator.

b. The Lockout / Tagout Coordinator shall discard the tags and maintain the completed Lockout / Tagout Request Permit for future reference.

c. In the event that an employee leaves the job site without removing the personal lock I tag, the following measures shall be taken and documented. The measures listed below are a minimum set of guidelines and under all circumstances, refer to the site-specific safe work plan for detailed procedures:

- Attempt calling / contacting the employee to return to the site for removal.
- In the event an employee cannot be contacted, the Site Manager and Safety Manager shall sign an Emergency Lockout/Tagout Removal Form, which has been completed by the Area Supervisor.
- Employee shall be notified upon returning to the site, prior to beginning any work.

5. INTERRUPTION OF A LOCKOUT / TAGOUT

Operational Emergency

The Engineer in Charge / Safety Manager /Area Supervisor may deem it necessary to temporarily remove the locks and tags from isolation devices, prior to the end of the work activity. The standard procedure for removal of locks and tags shall be followed. Extreme caution shall be taken by the Isolator removing the locks and tags to prevent personnel injury.

Testing

When the performance of a work activity requires the functional testing of a machine, component, or system, the locks and tags may be temporarily removed in accordance with the tag removal, to perform the test. As a result of the testing, if it is determined that the equipment needs further work, the locks and tags shall be positioned back on to the device. If it is not necessary to replace all the locks and tags, then the unnecessary locks and tags may be returned to the Lockout / Tagout Coordinator. The Engineer in Charge shall initial the Lockout / Tag out Request Permit in the removal block to indicate that these locks and tags have been removed. When testing has been satisfactorily completed, the locks and tags shall be removed.

ISOLATION DEVICES

- In most industrial applications, there are isolation devices that were not designed to accommodate a locking device. In these instances, an acceptable alternative that physically obstructs or prevents the use of the isolation device shall be found. Chains shall be placed on valves or electrical panels. Wires shall be determinate, pulled back, taped, and secured.

- If an isolation device does not accept a lock, a tag only is acceptable; however, all possible precautions shall be undertaken to provide a level of safety for the workers. The tag shall be readily visible to anyone attempting to operate the device.
- If more than one Lockout / Tagout Request Permit requires that a single isolation device be locked and tagged, a lock and tag for each request shall be placed. Each lock in itself prevents the inadvertent operation of the device.

GROUP / COMPLEX LOCKOUT

In a multiple lockout / tag out procedure, each person working on the machinery or equipment must place a lock or tag on the energy isolating device. If the energy isolating device will not accept multiple locks or tags, a hasp (a multiple lockout device, may be used. The locks or tags must be placed in such a way that energy cannot be restored to the machinery or equipment until every lock or tag is removed. As each employee involved no longer needs to maintain lockout / tag out protection that employee removes his - her lock and/or tag. The employee attaching the lock or tag is the only person authorized to remove the lock or tag.

6. TRAINING

The training must include recognition of hazardous energy source, type and magnitude of energy available, methods and means necessary for energy isolation and control. Each authorized employee shall receive adequate training. The training should address that all affected employees are instructed in the purpose and use of the energy control procedure. There should be training provisions included for any other employee whose work operations are or may be in an area where energy control procedures may be utilized. The employee training should also address when tag out systems are used including the limitations of a tag (tags are warning devices and do not provide physical restraint). The training should also include that a tag is not to be removed without authorization. The tag is never to be ignored or defeated in any way. Retraining is required when there is a change in job assignments, in machines, a change in the energy control procedures, or a new hazard is introduced. All training and I or retraining must be documented with employee's name and dates of training.

7. PROGRAM REVIEW

The lockout / tag out program must be reviewed at least annually. The review must ensure that procedures are being followed and that they are effective. A documented review of the inspection must include the date, the equipment, employees involved & the inspector. The inspector must be someone other than those actually using the lockout / tag out in progress.

ATTACHMENTS

#1. Danger (DO NOT OPERATE) Tags

#2. Device & Personal Locks and Multi Lock Hasp:

#3. Lockout / Tagout Request Permit

BHEL	**LOCKOUT / TAGOUT REQUEST PERMIT**	LOTO Request Permit No.:
		Work Permit No.:
Equip. Out of Service:	LOTO Date Required by: _____/_____/_____	Estimated Duration:
		LOTO Requested Date:
Scope of Work:		**LOTO Authorization** Signed by:
		Date:
		LOTO Removal Authorization Signed by:
		Date: Time:

Tag No.	Device to be Tagged / Locked I.D. No.	Device Location	Device Position *OPEN / CLOSED* -	Lock No.	Tag/Lock Placed by Print/Sign - Date/Time		Tag /Lock Removed by Print/Sign - Date/Time	

Comments Instructions: **Attachment 3.Lockout / Tag out Request Permit:**

#4. Lockout / Tag out Request Log

LOTO Permit No.	**Requestor Name**	**Equipment & Location**	**Est. Work Completed Date**	**Approval Date**	**LOTO Placed Date**	**LOTO Removed Date**	**Comments**

14. RISK ASSESSMENT

Risk and Hazard Analysis

In order to produce an overall Project EHS Plan, a project must be assessed for its risks. There are two components to the risk and hazard analysis. The procedure used to examine and plan for the identified risks and hazards is called a General Hazard and Risk Assessment.

JSA/HIRA review

Prior to commence the following activities Method statement and JSA/HIRA to be prepared by the concern engineer in coordination with EHS officer and submit to the client for review and approval. After getting approval the work will be started under PTW after clearance. For HIRA and criteria for the defining the high, medium & low risk the relevant annexure be referred. In case any deviations required in the approved method statement the concerned engineer/supervisor has to prepare additional HIRA/JSA to cover the new activities and associated risk. Following activities to be covered,

- Deep excavation (more than 5 feet)
- Significant concrete pouring (like heavy foundation, TG deck, Slab casting etc.)
- Confined entry
- Blasting
- Working on electrical/ energized equipment's
- Steel erection more than 5-Ton weight
- Working at height prior to completion of stairs/ladders/hand railing etc.

Definition:

HAZARD - Any potential or present danger to persons or property within the project site, e.g., oil on the floor is a hazard.

INCIDENT - An unintended happening that may result in injury, loss or damage, e.g., Slipping on the oil is an Incident.

INJURY – Physical harm, the result of an Incident, e.g., a sprained wrist from the fall would be an injury.

Hazard Analysis Document

- For high risk and dangerous work identified, the Applicant shall complete and submit a Hazard Analysis Document together with the PTW request. It will be a JSA (Job Safety Analysis) or Preliminary Hazard Analysis Checklist. And it shall be reviewed and approved by respective Construction and HSE Representatives.
- Issues such as work interface, coordination, drawings, toolbox meetings and work type/duration shall be detailed and included with supporting documentation for the Applicant's request for PTW.
- If applicable, Hazard Analysis Document shall be used as the foundation for development of Safe Work Method Statement. Each hazard identified shall be addressed in the Safe Work Method Statement and be submitted as part of the Applicant's submittal package.

Evaluation of Sub-contractor Risk Assessments includes

- Experience and expertise in performing similar type work.
- Duration of work performed
- Location of the work to be performed.

- Nature of the work to be performed.
- Potential for a subcontractor performing the work to expose themselves, other persons or employees, to hazards.
- Potential for exposure to work site hazards.

Review of Subcontractor specific issues

Preventive and protective measures must be introduced according to the following order of priority

- Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.
- Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

15. HSE PREPAREDNESS FOR ADVERSE CLIMATES AND WEATHER

All Preventive and Precautionary measures to ensure Health & Safety of workers in all possible adverse weather conditions based on the analysis of the local area conditions to be taken by the subcontractor

15.1 SUMMER

1. The Working Time and Lunch Hour will be as per instruction of Statutory Authorities (no work between 11am to 3:30pm). However, in case temp comes down due to rain/cloudy weather work will continue as per normal routine.
2. During long lunch break, worker will be allowed to go back home for rest. Those who will like to stay back will avail at the facility of rest shed or other designed area.
3. They will be allowed to take small break during work as per their need.
4. Water sprinkling will be done on roads to reduce dust concentration.
5. Workers will be provided with adequate cool drinking water and Butter milk/Lemon water etc.
6. Adequate ORS stock will be made available at the work location in the First-Aid Box for use as needed and at First-aid Centre for emergency need.
7. Fire prevention shall be on high alert, with removal of dry grass and bushes, etc, inside and outside the surrounding work areas. No smoking, and control of open flame/sparks shall be maintained and monitored.
8. Worker will be informed about the Do's and Don'ts to be followed during summer in the Pre Job Brief.

Dos & Don'ts

1. Drink plenty of cool water and other non-alcoholic fluid and keep body well hydrated.
2. Eat salt in food to replenish loss of salt through sweating.
3. Avoid over physical exercise.
4. Have adequate sleep at night.
5. Eat light and less spicy food
6. Avoid eating food which was cooked long time ago.

7. Nobody should use small water bodies such as pits, running rain water through crevices etc. for drinking and cleaning purpose as it may be unhygienic.

Emergency Handling

In case of emergency due to heat disorder:

1. Rescue the victim from workplace and place under shed.
2. If to be rescued from height, use stoke basket or rescue kit.
3. Inform Ambulance immediately.
4. If nearby any air conditioned room/shed is available, place him inside the room/shed.
5. Administer First aid by trained First aider for Heat Disorder
6. If conscious, give him ORS solution to drink.
7. If required send the victim hospital immediately.

15.2 MONSOON

A. Height Work & Structural Safety:

1. Ensure that all height work platforms are barricaded and avoid any highly hazardous
2. Height work.
3. Ensure that all personnel have good quality and intact safety shoes
4. Stop all dangerous height work during rain
5. Explain Do's and Don'ts to workers during Tool Box Meetings
6. Ensure that there are no weak structures, boards etc. that can fall during high winds
7. Do not allow any loose material (e.g. GI sheet, Ply board, empty cement bag, aluminium foil, foam sheets etc.) on roof sheds or top of structures.
8. Do not permit any one to ride up or come down scaffolds frame work during heavy wind or rain.
9. Provide "anchor" of adequate strength to scaffolds and other high-rise structures.
10. All rest sheds and GI sheds will be anchored into the round and wall and roof panels will be secured with J hook to prevent shed from blowing over or parts/pieces becoming airborne. Proper earthing per IS standard is also to be installed.
11. Do not go alone nor permit anyone to stay at tower-tops, roof-tops, high structures or on electrical poles during the course of stormy weather or heavy rain.

B. Electrical:

1. All electrical connections / loads have to be routed through ELCB / RCCB (residual current circuit breaker) whose rating should be 30mA.
2. RCCB operational checks need to be done DAILY / WEEKLY during monsoon season.
3. Avoid joints on power cables which need to be laid over-head or under-ground, better not to have any joint at all. In case joints become essential, such cables must be housed rigidly and insulation must be provided as per approved standard. The joint shall be suitable for outdoor use.
4. All electrical distribution board shall be properly covered at top and sides to protect from rain water. Extension boards shall be protected from rain water.
5. Ensure proper "earthing" for each and every electrical appliance.
6. Double earthing need to be provided for 3-phase power supply and for voltage more than 220V.

7. Provide lightening arrestors at the top of Boiler 3 and boiler 4 and rest sheds which are not covered by existing lightening arrestor of other installation.

C. Others:

1. Maintain smooth flow on open drains. i.e. no obstruction or blockade shall be made on storm water drains. If required, make temporary drains.
2. Arrange back-filling of excavated pits on war-footing basis.
3. Arrange bringing down booms of all cranes, hydra machines during stormy weather (wind speed 40-50 km/hr)
4. Confirm that all gantry cranes are effectively choked to prevent rolling and toppling.
5. Do not forget to deep ready a dew battery operated lights at site-offices during rainy season.
6. Avoid using wet damp clothes.
7. Hard Barricade excavated zone filled with water with scaffolding pipe & clamp with reflective net
8. Engage diesel operated water pump to dewater work area. For electrically operated water pump, the starter shall be protected from rain water. All rotating parts shall be guarded. Ensure availability of sufficient water pumps.

D. Health and hygiene:

1. Monsoon reduces the immunity of our body and makes us vulnerable to many diseases which are commonly associated with this season. It is time for us to keep our body challenging against disease by boosting our immunity and taking safety measures against these diseases.
2. The diseases associated with monsoon are Malaria, Jaundice, Gastro-intestinal infections, like typhoid, cholera etc. apart from these viral infections like cold and cough also make their presence felt. Majority of above said diseases are on account of:
3. Puddle of water formed due to rain become breeding grounds for mosquitoes which spread disease like, malaria and dengue fever. As a precautionary measure against mosquito-bite disease one can use mosquito net around the end which is better choice to mosquito repellents like mats and coils.
4. Pollution of drinking water during monsoon is very common. It is very necessary to drink clean and pure water when water-borne monsoon diseases like diarrhoea and gastro-intestinal infections threaten us.
5. Walking in dirty water during rainy season leads of numerous fungal infection which affect toes and nails. Diabetic patients have to take a special care about their feet. Keeping feet always dry and clean is very necessary. Avoid walking in dirty water. Keep shoes socks and raincoats dry and clean.

E. Workmen will be made aware of following Do’s and Don’ts:

1. Do not sleep in daytime.
2. Avoid over physical exertion.
3. During lightning and thunder storm, do not take shelter under tree. Take shelter inside rest shed or store room.
4. Wash vegetables with clean water and steam them well to kill germs.
5. Avoid eating un-cooked foods and salads should be washed properly before consumption.
6. Drink plenty of water and keep body well-hydrated.
7. Always keep the surrounding area dry and clean. Don’t allow to get water accumulated around.
8. Keep body warm as viruses attack immediately when body temperature goes down.

9. Do not enter air conditioned room with wet hair and damp cloths.
10. Dry your feet and webs with soft dry cloth whenever they are wet.
11. Eat light and less spicy food.
12. Avoid eating food which was cooked long time ago.
13. Eat salt in food to replenish loss of salt through sweating.

15.3 EMERGENCY WEATHER CONDITIONS

Cyclone/Severe thunder storm

In the event of Cyclone/Severe thunder storm, alert will be issued by subcontractor on notification received by Govt. authorities/Metrological departments Customer or BHEL.

The actions required during cyclone/rough weather:

1. Check and advice subcontractors to clean-up work area. Pick up all loose and unused material of respective supervisor's area.
2. Tie to secure all gas cylinders to avoid displacement and unsafe conditions which could be due to wind pressure.
3. Secure portable electricity generating sets and other equipment, pumps, hoses etc.
4. Make preparation for removal of water logging.
5. Take review of work activity and make preparation for removal of equipment and material from vulnerable areas.
6. Isolate/turn off all electrical power form the main panel/switches. Secure and anchor panels properly.
7. Recheck anchorage/tie of all temporary structures/sheds, tall objects, cranes, rigs, scaffolds etc. to avoid toppling due to wind force.
8. Cranes boom shall be secured, either locked or lowered the booms as reasonably and practicably possible and rigs to safe position for the safety point of view.
9. Group up all trash barrels, wooden pallets, forms; wooden decks etc. and anchor properly.
10. Welding machines, air compressors and such equipment are to be grouped together and secured to the stable objects. Welding leads, electrical cables, hoses are to be rolled up and secured properly.
11. Set on site vehicles on high ground in the site area with brakes set firmly.
12. Anchor all tanks, vessels, gas cylinders that may be moved by high wind and water.
13. Evacuate job site.

Personnel Evacuation:

1. Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the instructions from Govt. Authorities/ Metrological departments or Customer.
2. Once the warning is received for personnel evacuation, an emergency response team shall be formed. The team will work with local authorities and other agencies formed/deployed to evacuate and transport all personnel involved in the project to the cyclone shelter.
3. Cyclone may be followed by the calm "EYE", be aware of it. If the wind suddenly drops, don't assume the cyclone is over. Violent wind may resume from the opposite side direction. Wait for the official "All clear Signal".

4. After the cyclone, do not go outside until officially communicated about safe situation outside. Use recommended routes for returning. Do not panic or rush while returning.
5. Checking of gas leaks and well-being of electrical appliances is essential before leaving the site.
6. Follow local communications for official warning and advice. The construction Manager shall also obtain updates from customer/metrological departments and communicate to the personnel on project site.

15.4 PREVENTION OF COVID-19 (COVID-19 HERE TO BE READ AS COVID-19 AND OTHER PANDEMICS/ COMMUNICABLE DISEASES) AT PROJECT SITE & LABOUR COLONY:

Resumption of Construction Activities after Lock Down and Prevention of Coronavirus Infection during Site Operations and OCP 61A: Prevention of COVID-19 Infection in Labor Colony will be strictly followed.

A. <u>Preventive measures at project site:</u>

- BHEL and Agencies shall nominate COVID Marshalls, who will be responsible for monitoring the COVID prevention measures and apprising management on the same.
- Mandatory health check-up for every worker/ official joining the site
- All activities to be carried out using least amount of paperwork and physical proximity as far as possible.
- ***HSE Observer App*** to be used to monitor HSE Activities and follow up with agencies for closure of non-conformities.

<u>a. Strict Control at the Gate/ Banning Entry to Anyone Not Wearing Masks</u>

i. Security personnel at the gate may erect a barricade preferably approx. 10 meters from the gate and only allow personnel who are wearing proper masks inside.

ii. Public address system may be used to warn any non-compliant visitors

iii. Near entry gate, round markers at minimum 1-meter distance to be ensured so that distancing is ensured

iv. A hand-wash or hand sanitiser facility is preferable at the gate to allow entry after hand wash or hand sanitisation. These are also to be provided at key locations to enable hand wash / hand sanitisation before starting work, before eating, etc.

v. Gutkha, Paan, tobacco etc. to be banned from the site. Spitting to be strictly prohibited.

<u>b. Screening at Gate with Contactless Thermometer & Action on Suspected Cases</u>

i. Security Personnel at the Gate to screen each person entering the premises using a non-contact infrared thermometer, which is duly serial numbered and calibrated.

ii. In case any site worker/ official is found to have fever more than 99 Degrees Fahrenheit or found coughing/ sneezing, he/she may be advised rest till recovery and entry to be permitted after obtaining clearance from medical officer/assistance/attendants.

- Parcel to be collected from gate by concerned person preferably with provision of Special Box
- Any construction material received at site, unless properly sanitized, to be kept undisturbed for at least 3 days and to be used only after that period.
- During Toolbox Talks, minimum 1-meter distance between any two workers to be ensured

<u>c. During site execution activities:</u>

For all site execution activities, social distancing is to be maintained. In case this is not possible due to nature of work, speciality of work, etc, ensure sensitisation of the labour/staff involved and use of appropriate PPEs, especially mandatory face mask. In any case, close working to be allowed only in special

circumstances and ensuring these activities are preferably time staggered to the extent possible

d. In office premises:

i. Sharing of items like pens, water bottles etc. in office premises to be avoided

ii. Doors preferably to be in open condition to avoid contact

iii. All common touch points to be frequently disinfected in a day.

e. Regular disinfection of all Areas, Equipment and facilities

i. A dedicated disinfectant gang to be identified for the task by each agency. The disinfectant gang to be provided full body suits for the task.

ii. All areas (including office premises, site areas, chairs, tables, furniture etc.), tools & equipment to preferably be disinfected by dedicated gang every day before resumption of work.

iv. Common touch points like handrails, lift buttons, door/window knobs or handles, vehicle door handles, taps, conference room & dining hall tables/chairs, common sofas/chairs, visitor sofa/chairs, files & folders, etc to preferably be disinfected regularly at frequent intervals every day.

v. Pool vehicles, to be disinfected after every use. Social distancing to be maintained inside the common pool vehicles as per Govt./ statutory body guidelines.

f. Disinfecting the operator/driver touch points of Vehicles/cranes, T&Ps etc.

Disinfection to also be carried out for all Cranes, Vehicles, Equipment, consoles, T&Ps etc. which come into contact with operating personnel.

g. Posters on COVID-19

Sufficient Posters on COVID-19 to be ensured across the site in languages understood by most workers.

h. Brief guidelines for hand washing are as below:

i. Soap to be provided at each wash basin and replenished regularly.

ii. Washing with soap for at least 20 seconds is recommended.

iii. As a general guideline, for every 100 workers, 1 wash-basin may be provided at site areas.

iv. Close queue to be avoided near wash-basins and 1-meter distance to be maintained. Round markers at 1-meter distance can be ensured as guidance

Composition of Disinfectant:

i. Readily available 1% hypochlorite solution or 4%

ii. Liquid chlorine-1% solution

Iii. Surgical spirit-95% alcohol content

iv. Hand sanitizer should have: Isopropyl alcohol-75%, Gycerol-1.45%, Hydrogen Peroxide-0.125%

B. Prevention of COVID-19 Infection in Labor Colony:

- Spacing of minimum 2 meters between living areas of workers inside a room may be maintained. Preferably, the living area of each worker may be partitioned using sheet of cloth, plastic etc.
- Rooms to be properly ventilated as far as possible
- Sanitation to be given prime importance and personal hygiene to be promoted
- Face masks shall be worn by everyone inside the colony premises
- Spitting of Pan. Gutkha etc. inside the colony and urinating etc. outside the toilets to be strictly avoided
- Regular visits by Doctors to the labor colony can be arranged on non-working day for check-up of all workers
- **Identification of "COVID Wardens" (CWs) by each agency for maintaining the following:**

  i. Keeping an eye on the health of workers and report any suspected cases of fever, coughing etc. to the

management

ii. Keeping an eye on the social distancing measures in the labor colony and report any non-conformances to the management.

iii. Educate the workers about social distancing and COVID prevention measures.

- Training/ Awareness regarding COVID-19 to be provided to workers regularly.
- Workers to be instructed to maintain social distancing of minimum 1 m at all time
- **Posters on COVID-19:** Sufficient Posters on COVID-19 to be ensured across the labor colony in languages understood by most workers.
- All workers to be instructed to inform any suspected cases of illness (individual or others) to an emergency contact number of CW, the emergency contact numbers and CW contact numbers to be displayed at prominent locations
- **Inspection & Review**

  i. Daily Inspection by concerned COVID Wardens and reporting to Agency

  ii. Regular inspection by Agency & BHEL

15.5 Noise Mitigation

High noise is harmful to the human health and it can cause impairment if exposed for long duration at regular intervals, and also cause disruption in nearby communities.

- Noise monitoring shall be carried out in all construction locations periodically.
- Use of silent DG is allowed at site during construction.
- Low noise generation equipment's to be preferred.
- Work areas where noise levels exceed the 85db shall be posted as hearing protection required.
- Use of PPEs / ear plug/ear muff for personnel entering into high noise area.
- Activities generation High noise will be planned in day shift.

Noise Level Chart

Parameter	Night Noise level dBA	Daytime Noise Level dBA
At 1-meter from each piece of equipment	85	85
At Property boundary	70	70

ANNEXURE J

First-Aid Box

Details & Contents of First Aid Box as per Contract Labor (Regulation & Abolition Act), Central Rules, 1971

(1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

(a) For establishments in which the number of contract labor employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labor Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labor exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.
(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labor Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

ANNEXURE K

Vertigo Test

Vertigo Test Procedure/ Guidelines

This document specifies minimum requirements for vertigo test. These may be supplemented by any additional requirements deemed fit by the medical examiner/ HSE department)

Fear of height may be physiological or psychological. Therefore, to rule out any possibility of physiological factor, detailed medical check-up of workers is carried out before vertigo test. Medical check-up of workers includes the following:

history of past illnesses (like epilepsy, drug allergy, diabetics/ hypertension, unconsciousness etc.), general physical examination (like height, weight, BMI, build and nourishment etc.), measurement of pulse rate, Blood Pressure, respiratory rate.

After this check-up, those who are found suitable for height work by examining doctor, are allowed to undergo vertigo test.

During this health check-up, psychology of workers is also studied. If any worker finds it extremely difficult/ frightening to climb the monkey ladder & walk on the beam, during/after performing vertigo test or even before performing, then he is treated as disqualified.

As per standard, during vertigo test, worker is allowed to climb on a foundation through monkey ladder, walk on a beam, then steps down at the other end of beam, through monkey ladder. Height of the beam should be at least six feet from ground level. All necessary safety precautions are taken during this test. Worker has to wear full body harness with double lanyard. A horizontal lifeline is run parallel to the beam and worker has to put his lanyards into the lifeline. Additionally, a safety net is also put below the beam for rescue of the victim in case of a fall from beam.

Following activities are suggested to be carried out during testing:

1. **Walking Bench Training:**
   a. Person should walk over the channel. He should maintain balance & walk without much problem.
   b. If the person has problem to balances himself on repeated chances, he may be having flat foot or some other problem. So, he may not be fit for height work.
2. **Rope Climb Training:**
   Person should be able to climb the rope up to the top channel for ensuring that in case of fall, a person hanging on the safety harness, will be able to safely climb back to the platform within minimum time period before the safety harness start breaking down under the load.
3. **Height Work Training:**
   Person should walk freely on the middle channel while holding the top channel with the help of safety harness.
4. **Ladder for Vertical fall arrestor Training:**
   Vertical fall arrestor rope is fixed from top to bottom of the ladder. It will ensure:
   - Usage of vertical fall arrestor.
   - Usage of two lanyards of a safety harness.
   - Ensure 3-point contact on the ladder while climb.
5. **Chair for work at height Training:**
   - Climb though vertical ladder with two lanyard ropes.
   - Hooking of two lanyard ropes to life line. With this safe arrangement, he can walk to chair.
   - Sits in the chair safely, comes out & walks back to the vertical ladder & come down from vertical ladder. After completion of vertigo test, blood pressure of worker is again measured. If it is not within acceptable limits for any worker, concerned worker is denied height pass.

Only those who pass the above training are to be considered as fit for height work.