

VOLUME – IA
Part I & II
TECHNICAL
CONDITIONS OF
CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

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VOLUME-IA PART-I CHAPTER-I PROJECT INFORMATION

Coal Fired Steam Generator(300TPH), Turbo-generator(1X18.5MW), Sox and NOx Control System and its auxiliaries along with associated facilities for Steam and Power Plant

1.1.1.1.	Project Title	:	5th Stream Alumina Refinery Expansion at Damanjodi, Odisha
1.1.1.2.	Owner	:	National Aluminium Company Limited
1.1.1.3.	Plant site location	:	Damanjodi village, Semiliguda block, Koraput District ,Odisha
1.1.1.4.	Location co-ordinates	:	18.82°N 82.72°E
1.1.1.5.	Nearest Village	:	Damanjodi, Odisha
1.1.1.6.	Nearest Town & City	:	Koraput (36 km)
1.1.1.7.	State Capital	:	Bhubaneswar (475 km)
1.1.1.8.	Nearest Railway Station	:	Damanjodi Railway Station (6 km)
1.1.1.9.	Nearest Airport	:	Domestic airport at Vishakhapatnam (140 km)
1.1.1.10.	Nearest Seaport	:	Vishakhapatnam (140 km)
1.1.1.11.	Nearest Road access	:	10 km from South west of NH 26
1.1.2.	Meteorological Condition		
1.1.2.1.	Site Elevation	:	910 m avg. altitude from mean sea level
1.1.2.2.	Temperature		
a.	Maximum Dry bulb temperature	:	46.6°C
b.	Minimum Dry bulb temperature	:	3°C
c.	Ambient temperature for design purpose	:	35°C
1.1.2.3.	Relative Humidity for design purpose		70 ± 20%
1.1.2.4.	Annual Rainfall		
a.	Average	:	1430 mm (avg.)
1.1.2.5.	Basic Design Wind Pressure	:	As per IS: 875 (Latest Edition) 50m/sec
1.1.2.6.	Wind Direction	:	Predominantly in Southwest direction
1.1.2.7.	Seismic zone	:	Zone II as defined in IS:1893-Part-I

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VOLUME IA PART I CHAPTER II

SCOPE OF WORKS

- 1.2.1. Erection, Testing & Commissioning of Electrical, Control and Instrumentation (C&I) works, Illumination works including Handling of materials at site BHEL stores / storage yard, transporting to site of erection and supply & application of final painting, including obtaining statutory clearances if any, for Boiler & Aux, ESP, Steam Turbine, Generator & auxiliaries, complete Piping, SCR system, FGD and BOI items of Steam-cum-Cogeneration Power Plant at 5th Stream Alumina Refinery Expansion at Damanjodi, Odisha of M/s NALCO, 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. **SCOPE OF WORK IN GENERAL:**
- 1.2.2.1. The Scope of Work covers the complete work of Handling at Storage Yard/Stores, Transporting to site, Calibration, Pre-Assembly, Erection, Pre-Commissioning Checks & Tests, Commissioning, supply & application of final painting, including obtaining statutory clearances if any and Handing Over of Electrical, C&I Works, Illumination works of Steam-cum-Cogeneration Power Plant at 5th Stream Alumina Refinery Expansion at Damanjodi, Odisha of M/s NALCO, and comprising mainly of
- Boiler & Aux, ESP
 - Steam Turbine, Generator & auxiliaries
 - Complete Piping
 - SCR system
 - FGD
 - BOI items and Misc. items
- 1.2.2.2. The scope of work covers identification of items at stores / yards, technical assistance for checking and making the shortage / damage reports, taking delivery from storage yard/ stores, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, calibration, checking, erection, carrying out statutory tests as required, commissioning & post-commissioning activities of Electrical & C&I systems upto trial operation of all systems (Boiler & Auxiliaries, ESP, Steam Turbine, Generator & Auxiliaries, Complete Piping, SCR, FGD, BOI items and other miscellaneous items) and handing over to customer or till completion of contract period whichever is earlier, along with supply of all consumables, tools and tackles and testing instruments.
- 1.2.2.3. The installation and commissioning of all the electrical equipment / items shall conform to the technical requirements specified elsewhere in the tender.

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- 1.2.2.4. It is not the intent to specify herein all details of material. Any item related to this work not covered by this specification, but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.2.2.5. The scope of specification covers the installation, testing and commissioning of the electrical equipment, hardware along with accessories as detailed in Bill of Materials (BOM).
- 1.2.2.6. Receipt of materials / component to be erected by the contractor, loading and transportation from the storage yard to the project site, stacking, storage and preservation.
- 1.2.2.7. Preassembly, Erection, Testing, Commissioning, Trial operation and reliability operation of equipment.
- 1.2.2.8. Supply of consumables, Final painting including supply of paints, wherever applicable.
- 1.2.2.9. 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.
- 1.2.2.10. 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. Deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipment, testing instruments (except proprietary type instruments), returning of un-used materials / items to BHEL stores.
- 1.2.2.11. Contractor shall possess valid electrical license to carry out the Electrical works indicated in the BOQ.
- 1.2.2.12. Scope also covers on getting Electrical Inspector/statutory authority's approval for charging of all HT installations of the Project.
- 1.2.2.13. Minor Civil Works as detailed elsewhere in the tender specification is in the scope of the contractor.
- 1.2.2.14. Any other Electrical and C&I works not specifically mentioned but required for completion of the Electrical and C&I package.
- 1.2.3. **SCOPE OF ELECTRICAL WORKS IN GENERAL**
- 1.2.3.1. Erection and Commissioning of Transformers (Generator Transformer, Auxiliary Transformers, etc.)
- 1.2.3.2. Erection and Commissioning of LT Busducts

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- 1.2.3.3. Erection and Commissioning of HT/LT Switchgears including HT Isolation Panel, AC/DC Distribution Boards, Starter Panels, Electrical Control Panels, DAVR etc.
- 1.2.3.4. Erection and Commissioning of Battery & Battery Charger
- 1.2.3.5. Installation of NGRs
- 1.2.3.6. Laying and termination of HT/LT cables including supply of ferrules, tag plates, and cable dressing materials as detailed in scope of cabling for specific systems identified etc.
- 1.2.3.7. Installation of Local Push Button Stations, Junction Boxes etc.
- 1.2.3.8. Installation of above ground earthing grid, equipment earthing, electrical and electronic earthing
- 1.2.3.9. Installation of lightning protection system
- 1.2.3.10. Fabrication and installation of steel supports wherever required.
- 1.2.3.11. Erection and Commissioning of Illumination Package like installation of Lighting Poles, lighting panels, light fixtures, Receptacles, Conduiting, Wiring etc.
- 1.2.3.12. Commissioning of Generators, HT/LT drives, electrical hoists, electrically operated equipment erected by Mechanical Contractor.
- 1.2.3.13. Commissioning of ESP HV Rectifier transformers & Disconnecting switches
- 1.2.3.14. Commissioning ESP Heaters, thermostats, interlocking systems
- 1.2.3.15. Supply of paints and painting of items covered in the scope of work, as detailed elsewhere.
- 1.2.3.16. Supply of all consumables required for installation as detailed elsewhere in the contract.
- 1.2.3.17. Installation of any other items that have not been specifically indicated, but required for completing installation.

Note: If any peripheral Electrical 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.

1.2.4. **SCOPE OF CONTROLS AND INSTRUMENTATION WORKS IN GENERAL (AS APPLICABLE):**

1.2.4.1. **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.

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- (ii) All Analyzers (in stack, FGD, SCR)-Oxygen, HF, Flue Gas (SOX/NOX/CO), Mercury, NH₃, CO, SOX, NOX, Opacity, etc.
- (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, etc.)
- (v) Microprocessor based flame scanner system, H.E.A Exciter system, 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)
- (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.

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

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

1.2.4.3. **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.

1.2.4.4. **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.

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- (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, 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

1.2.4.5. **EXCLUSIONS:**

- (i) 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. **SCOPE OF ILLUMINATION WORKS IN GENERAL (AS APPLICABLE):**

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

1.2.5.1. **Erection and Commissioning of:**

- a. Lighting Luminaires (complete with accessories)
- b. Steel Tubular Poles
- c. GI poles
- d. Laying of Conduits including laying of wires
- e. Junction Boxes Switchboards, Receptacles, Switches, etc.
- f. Lighting Panels (LP)
- g. Lighting transformers
- h. 75 kVA Normal Lighting transformers
- i. Lighting Distribution Boards

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1.2.5.2. **Others:**

- a. Final Painting as detailed in scope of respective item/ equipment.
- b. Supply of consumables other than BHEL supplied as detailed elsewhere in this specification, required for installation.
- c. Embossing Permanent nomenclature on equipment erected as per site requirement.
- d. Necessary arrangements for Protecting and safeguarding the Erected equipment from any damages and pilferages.
- e. Fabrication and installation of steel supports wherever required.
- f. Installation of any other items that have not been specifically indicated, but required for completing the Illumination works.
- g. For installation of the above, minor civil works as detailed elsewhere in the specification.

1.2.5.3. **Note**

If any peripheral illumination item associated with the above said main equipment required for complete commissioning, the same shall also be erected and commissioned by the contractor within the quoted rate

- 1.2.6. 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.

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

Sl No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.	PART I			
1.3.1.1.	ESTABLISHMENT			
1.3.1.1.1.	FOR CONSTRUCTION PURPOSE:			
1.3.1.1.1.1.	Open space for office	Yes		Free
1.3.1.1.1.2.	Open space for storage	Yes		Free
1.3.1.1.1.3.	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
1.3.1.1.1.4.	Bidder's all office equipments, office / store / canteen consumables		Yes	
1.3.1.1.1.5.	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
1.3.1.1.1.6.	Firefighting equipments like buckets, extinguishers etc		Yes	
1.3.1.1.1.7.	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.3.1.1.2.	FOR LIVING PURPOSES OF THE BIDDER			
1.3.1.1.2.1.	Open space		Yes	Refer Cl. No. 1.3.3.3.
1.3.1.1.2.2.	Living accommodation		Yes	
1.3.1.2.	ELECTRICITY			
1.3.1.2.1.	Electricity of Voltage 415 / 440 V For construction purposes			
1.3.1.2.1.1.	Single point source	Yes		Chargeable at 3 Points
1.3.1.2.1.2.	Further distribution for the work to be done which include supply of materials and execution		Yes	
1.3.1.2.2.	Electricity for the office, stores, canteen etc of the bidder which include:		Yes	

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1.3.1.2.2.1.	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.2.2.	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
1.3.1.2.2.3.	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.2.4.	Living facilities for office use including charges		Yes	
1.3.1.2.2.5.	Demobilization of the facilities after completion of works		Yes	
1.3.1.2.3.	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc. on the above lines.		Yes	
1.3.1.3.	WATER SUPPLY			
1.3.1.3.1.	<i>For construction purposes:</i>			Free
1.3.1.3.1.1.	Making the water available at single point	Yes		
1.3.1.3.1.2.	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.3.2.	Water supply for bidder's office, stores, canteen etc			
1.3.1.3.2.1.	Making the water available at single point		Yes	
1.3.1.3.2.2.	Further distribution as per the requirement of work including supply of materials and execution		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	
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			

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1.3.1.5.1.	Telephone, Fax, internet, intranet, email etc		Yes	
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	

SI No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART II			
1.3.2.	ERECTION FACILITIES			
1.3.2.1.	Engineering works for construction			
1.3.2.1.1.	Providing the erection drawings for all the equipments covered under this scope	Yes		
1.3.2.1.2.	Drawings for construction methods		Yes	
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	
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 erection schedules and other input requirements		Yes	
1.3.2.1.6.	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	In consultation with BHEL
1.3.2.1.7.	Weekly erection schedules based on SI No 1.3.2.1.5		Yes	
1.3.2.1.8.	Daily erection / work plan based on SI No 1.3.2.1.7		Yes	
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	

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		BHEL	Bidder	
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 himself			Not applicable

1.3.3. OPEN SPACE:

- 1.3.3.1 To establish a temporary site office, fabrication yard and storage area at the job site, minimum open space will be provided free of charges.
- 1.3.3.2 Location and area requirement for office / storage sheds / fabrication yard shall be discussed and mutually agreed to after award of work at site. Construction of his site office, covered store or any other temporary building shall be in contractor's scope. Security of stores & work place shall be in Contractor's scope.
- 1.3.3.3 Land for residential accommodation for Contractor's staff and labour, if available & as provided by NALCO Damanjodi, may be made available to Bidder outside plant boundary limit at the discretion of BHEL and rent for the same will be as decided by BHEL according to location and the area occupied by the Bidder.

1.3.4. ELECTRICITY:

- 1.3.4.1 Construction Power will be provided at 415 V at three (3 Nos.) different points at the nearest sub-station, as defined below, on chargeable basis, as charged by NALCO Damanjodi. **The present Rate is Rs.4.30/kWh** and any change in power tariff shall be intimated to the contractor:
- a.) One Point near BTG Area
 - b.) One Point Near Limestone Handling Area
 - c.) One Point near BHEL Site Office inside Storage Yard
- The contractor will make his own arrangement for temporary distribution of power from the nearest substation.
- 1.3.4.2 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.
- 1.3.4.3 Only motors up to 3 HP will be allowed to be started direct on line. For motors above 3 HP and up to 100 HP, a suitable starting device approved by the Engineer-in-Charge shall be provided by the Bidder. For Motors above 100 HP slipping induction motors with suitable starting devices as approved by the Engineer-in-Charge shall be provided by the Bidder.
- 1.3.4.4 Contractor has to make his own arrangements for his electricity requirement for his labor colony at his cost.

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- 1.3.4.5 The bidder shall have to provide earth leakage circuit breaker at each point wherever human operated electrical drives / T&Ps are deployed.
- 1.3.4.6 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.
- 1.3.4.7 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.
- 1.3.4.8 Necessary "Capacitor Banks" to maintain/ 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.
- 1.3.5. **CONSTRUCTION WATER**
- 1.3.5.1 Water for Construction purpose will be provided at one single point free of cost. Further distribution of water inside plant shall be by contractor.
- 1.3.5.2 Contractor has to make his own arrangements for his water requirement for his labour colony at his cost.
- 1.3.6. **ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS]:**
- 1.3.6.1 Contractor has to deploy 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 at the risk and cost of the contractor, if the required nos of PCs are not deployed by the contractor.
- 1.3.7. **CONSUMABLES:**
- 1.3.7.1. 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, and other materials for this scope of work are to be arranged by the contractor at their cost.
- 1.3.7.2. All the required electrodes (in his scope) as approved by BHEL & Customer shall be arranged by contractor at his 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.
- 1.3.7.3. 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.

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- 1.3.7.4. The contractor shall provide within finally accepted price / rates, all consumables 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), all gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, solvent cement for CPVC Pipes(as applicable), petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding and pre-assembly materials, hardware items etc required for temporary works such as supports, scaffoldings, bed 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.
- 1.3.7.5. 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.
- 1.3.7.6. All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.
- 1.3.7.7. In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same at the risk and cost of the contractor. The entire cost towards this along with standard BHEL overhead shall be deducted from the contractor's immediate due bills.
- 1.3.8. **MATERIAL SUPPLY:**
- 1.3.8.1. BHEL will supply the materials/equipments indicated in the weight schedule from their respective manufacturing units which are to be executed/incorporated in the permanent system. In addition, the material such as lube oil, grease, Ammonia required for commissioning the erected equipments and chemicals required for chemical cleaning of equipments will be supplied free of cost by BHEL.
- 1.3.8.2. For fabrication & erection of structures, racks & trestles etc., Steel as available in commercial market, shall be supplied by BHEL for item No. 2301(A) of Rate Schedule ID 9. However, for other components, material supply is in contractor scope, as given in Rate Schedule ID 9.
- 1.3.8.3. All fabrication & erection including all statutory clearances are in scope of contractor.

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1.3.9. **POSSESSION OF GENERATORS:**

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 only be given and contractor is not entitled for any compensation. It shall be the responsibility of the tenderer / 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 one no. of generator set to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by contractor. This may also be noted while quoting. No separate payment shall be made for this contingency.

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

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

1.3.11. **GASES:**

1.3.11.1. All the required gases like Oxygen / Acetylene / argon /Nitrogen required for work shall be supplied by the Contractor at his 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.

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

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

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

1.3.12. **ELECTRODES SUPPLY AND STORAGE**

1.3.12.1. The bidder shall use the Customer approved quality welding electrodes only.

1.3.12.2. 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 subjected to inspection and approval by BHEL. The contractor shall inform BHEL, details regarding type of electrodes, batch number and date of expiry etc.

1.3.12.3. 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

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- 1.3.12.4. Storage of electrodes shall be done in an air conditioned / controlled humidity room as per requirement, at their own cost by the contractor.
- 1.3.12.5. 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 his cost.
- 1.3.12.6. 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.
- 1.3.12.7. BHEL reserves the right to reject the use of any electrodes at any stage, if found defective because of bad quality, improper storage, date of expiry, unapproved type of electrodes etc. It shall be the responsibility of the contractor to replace at his cost without loss of time.
- 1.3.13. **OTHER FACILITIES**
- 1.3.13.1. Adequate water less urinals [at least 2 nos per level at suitable locations] shall be arranged by the contractor within quoted rates, at site of construction at different level and different areas like Boiler, ESP, TG 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)

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- (vii) Materials required for cable dressing (GI / Aluminium Flats, PVC Cable ties, etc)
- (viii) Anchor fasteners for wall mounted cable trays & JB's wherever required.
- (ix) PVC wire marker sleeves and tag plates
- (x) Lugs of size 2.5 sq.mm and below(as required)
- (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. **TENTATIVE REQUIREMENT OF ERECTION HARDWARE AND CONSUMABLES**
IMPORTANT TO NOTE: For E&C of the Illumination works BOQ mentioned in Chapter IX of Volume IA, Technical Conditions of Contract, following tentative Erection hardware and consumables as specified below will be supplied by BHEL manufacturing Unit which may be utilized by the contractor. The list is not exhaustive

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but tentative and the Qty is also tentative. The required items as well as the Qty may vary during actual E&C.

Sl. No	Description	Unit	Qty
1.	Saddle with saddle bar	Nos	33000
2.	GI steel Conduit branching JB	Nos	650
3.	Gland /Connector for fixing Flexible conduits	Nos	1400
4.	PVC conduit bend	Nos	7000
5.	PVC conduit coupler	Nos	7000
6.	PVC Conduit branching JB (Deep drawn type for concealed wiring at ceiling)	Nos	700
7.	PVC Conduit branching JB	Nos	2650
8.	PVC Ceiling Rose	Nos.	1200
9.	Check nuts for 20mm conduit	Nos	1500
10.	Spring loaded ball socket suitable for conduit branching round JB	Nos	600
11.	GI Clamp for LED Batten (For Surface mounting)	Nos	450
12.	Rubber grommet 25mm	Nos	100
13.	Rubber grommet 20mm	Nos	500
14.	Rawl plug 1.5" with screw	Nos	14000
15.	Galvanised anchoring Fastener 6mm dia x 35mm long (Bolt type)	Nos	6000
16.	Galvanised anchoring Fastener 6mm dia x 35/70mm long (Hook/Half ring type)	Nos	3500
17.	Galvanised anchoring Fastener 10mm dia x 68mm long (Bolt type)	Nos	900
18.	Cable clamps suitable for 3Cx2.5sqmm Cu. Armoured Cable	Nos	50000
19.	Cable clamps suitable for 4Cx25/35sqmm Cu. Armoured Cable	Nos	7500

All the required erection consumables like rawl plugs, screws, check nuts, nuts & bolts, locking wire, insulation tape, sealing compound/plugs, washers etc. which are not covered in above list but required for successful completion of the work shall be in the scope of Erection Agency. It is also to be noted that any additional hardware/consumables from the list is also to be supplied within the quoted rate. No additional payment will be made for extra items required for E&C.

1.3.17. **BID DRAWINGS**

1.3.17.1. Bid drawings published in this tender specification are for information and this may get revised during execution.

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

- 1.3.18.1. 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

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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. Tentative list of Major T&P shall be deployed for execution within quoted Price:
- Oil Filtration Machine of suitable capacity with all accessories -As required
 - Storage tank of suitable capacity with all accessories -As required
 - Sufficient quantity of Nitrogen Gas (with 99.999% purity and Dew point-50 or better) has to be arranged for top up during preservation of Transformers till the oil filling-As required
 - Mobile Crane 14 T capacity – As required
 - Crane of appropriate capacity-As required
 - DG Set of appropriate capacity-As required
 - 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--As required
- 1.4.3. 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

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Sl.No.	Description	Quantity
	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
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
29	Insulation tester:	
(i)	Motorized Megger - 0 - 1000 - 2000 - 5000V, 0 - 25000 M ohms (make: Kyoritsu) with PI option.	As required
(ii)	Hand operated Megger - 0.5 KV/1.0 KV/2.5 KV, 0- 1000 M Ohms	As required
30	Earth resistance tester 0 to 1, 10, 100 ohms	As required
31	Transformer oil test kit	As required

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Sl.No.	Description	Quantity
32	Torque wrench	As required
33	Voltmeter AC 0 - 125 - 250 - 625 V AC	As required
34	Ammeter AC 0 - 2A - 10A AC	As required
35	Wattmeter - ac/dc - 0 - 125 - 250 V 0-5-10A	As required
36	Multimeter - analogue: AC V 2.5V - 2500V, AC A - 100 mA - 10 A DC V 25.V - 2500V, dc A - 50mA - 10A	As required
37	Digital Multi meters (make: Fluke/equivalent) AC 0V-600V, DC 0V-300V	As required
38	Resistance - 0 - 200 M ohms	As required
39	Digital: voltages AC & DC - 100mv - 1000 V	As required
40	Current 10-mA - 10A Resistance - 0-20 M ohms	As required
41	Oil Filtration Machine 1 kl/hr for Oil filtration of ESP-High Voltage Rectifier transformer	As required
42	VARIAC - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A..	As required
43	Primary injection kit - 0-10000 A.	As required
44	Relays testing kit for Secondary injection test (Make: Omicron)- 0-5A.	As required
45	HV Test kit - 50 KV AC 400kVA.	As required
46	Wheat stone bridge - 0.05 m ohm - 100 ohm.	As required
47	Air compressor	
48	Oscilloscope	As required
49	Oil Tank for transformer oil filtration	As required
50	Winding inductance/capacitance test kit	As required
51	220V DC power pack for control supply required for testing of panels	As required
52	Vacuum pump.	As required
53	Phase sequence meter - 110V - 450V - 25 to 65Hz.	As required
54	Frequency meter - 0 - 115 - 230 - 4500 - 45 - 601/s.	As required
55	Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.	As required
56	Tachometer etc.	As required
57	SF6 filling and evacuating equipment.	As required
58	mA Source	As required
59	Standard pressure gauges – If required	As required

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Sl.No.	Description	Quantity
60	Temperature oil bath– If required	As required
61	Tan Delta Test kit – Only if HV transformers are include in rate schedule	As required
62	Oil specific gravity and PPM measuring Equipment-Only if HV Transformers are included in rate schedule	As required
63	Dew point measurement instrument kit	As required
64	3 Phase relay testing kit (Of type omicron etc.) To be brought when required	As required
65	Contact resistance measurement kit	As required
66	Micro Ohm meter	As required
67	Equipment for DGA test on Transformers (Guidelines attached in elsewhere in this specification)	As required
68	HT discharge rod (min 11 kV) – 3 sets (min)	As required
69	Lockout Tagout (LOTO) system for implementing during testing, commissioning & initial operation of Electrical equipment	As required
70	Insulating Rubber mats & Hand gloves (as required)	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" , 1/2" , 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

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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.

1.4.4. ACCURACY REQUIREMENT OF TESTING INSTRUMENTS

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

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Sl.No.	Instrument / Tool	Range	Accuracy	Dial Size
		Philips Current 20 mA to 20 A DC	$\pm 0.5\%$ + digit	
		Hcl Current 200 mA to 010 A AC	$\pm 1\%$ + digit	
02	Analog Multimeter	Voltage 2.5 to 2500V AC	$\pm 1.0\%$	
		Current 100 mA to 10A AC	$\pm 2.0\%$	
		Current 250 micro A to 1A DC	$\pm 1.5\%$	
		Resistance upto 100 ohms	$\pm 3.0\%$	
		Voltage 2.5 V to 2500 V	$\pm 1\%$	
03	MV/mV Source	0 to 200 mA / 200mV	0.2%	
04	Hand operated Megger 500V /1000 V	Upto 200 m Ohms	$\pm 5\%$ at Centre scale	10"
05	Standard Pressure Gauges	0 to 1 kg/cm ²	$\pm 0.25\%$ LC– 0.02 kg/ cm ²	10"
		0 to 6 kg/cm ²	$\pm 0.25\%$ LC– 0.1 kg/ cm ²	10"
		0 to 10 kg/ cm ²	$\pm 0.25\%$ LC– 0.02kg/ cm ²	10"
		0 to 25 kg/ cm ²	$\pm 0.25\%$ LC– 0.25kg/ cm ²	10"
		0 to 60 kg/ cm ²	$\pm 0.25\%$ LC– 0.1kg/ cm ²	10"
		0 to 250 kg/ cm ²	$\pm 0.25\%$ LC– 2.5kg/ cm ²	10"
		0 to 400 kg/ cm ²	$\pm 0.25\%$ LC– 2.5 kg/ cm ²	10"
		0 to 600 kg/ cm ²	$\pm 0.25\%$ LC– 2.5 kg/ cm ²	10"
		0 to 1000 kg/ cm ²	$\pm 0.25\%$ LC– 1.0 kg/ cm ²	10"
06	Dead Weight Tester	0 to 400	LC – 5 kg/cm ²	
		0 to 600	LC – 5	

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Sl.No.	Instrument / Tool	Range	Accuracy	Dial Size
			kg/cm ²	
07	Standard Hg in glass Thermometer	0 to 100°C	LC - 1°C	
		0 to 110°C	LC - 1°C	
		0 to 250°C	LC - 1°C	
		0 to 150°C	LC - 1°C	
		0 to 360°C	LC - 1°C	
		0 to 100°C	LC - 1°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%	
S.No.	INSTRUMENT / TOOL	RANGE	ACCURACY	
17	Power Pack	0 to 50V DC, 3A	± 2%	
18	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 up to 100 ohms	± 3.0%	
		Voltage 2.5V to 2500V DC	± 1%	
19		Voltage 200mV to 1000 V DC	± 1% + 1 digit	

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S.No.	INSTRUMENT / TOOL	RANGE	ACCURACY
	Digital Multimeter	Philips Voltage 200mV to 1000 V AC	$\pm 1\%$ + 1 digit
		Hcl Current 200mA to 20 A AC	$\pm 0.8\%$ + 1 digit
		Philips Current 20 mA to 20 A AC	$\pm 0.8\%$ + 1 digit
		Resistance (Hcl) 2120 200* to 200M*	$\pm 0.5\%$ + 1 digit
		Resistance (Hcl) 2105 200* to 200M*	$\pm 0.25\%$ + 1 digit
		Hcl Voltage 200mA to 750 V	$\pm 0.8\%$ + 1 digit
		Philips Current 20 mA to 20 A DC	$\pm 0.5\%$ + 1 digit
		Hcl Current 200 mA to 010 A AC	$\pm 1\%$ + 1 digit
20	Vibration Measuring Equipment	Velocity up to 50 mm/sec.	$\pm 0.5\%$ mm/sec
		Displacement up to 300 microns	± 2 microns
21	Secondary Injection Kit	Up to 5A	$\pm 0.5\text{mA}$
22	Motor operated Megger	up to 200 Ohms	$\pm 5\%$ at Centre scale
23	Tongue tester	0/300/600A AC	$\pm 5\%$
		0 to 300A DC	$\pm 5\%$
24	Tachometer (Hand held)	0 to 4000 rpm	+ 5%
25	Phase Sequence Meter		N/A
26	Three Phase Variac	15 A Capacity	N/A
27	Feeler Gauges	300 mm long and 100 mm long	± 2 microns
28	Dial Gauges	0 to 10mm	± 0.01 mm
29	Hand operated Megger 500V	Up to 1000 M Ohms	$\pm 5\%$ at Centre Scale $\pm 10\%$ at end of Scale

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S.No.	INSTRUMENT / TOOL	RANGE	ACCURACY
	/ 1000V/2.5 KV		
30	Motorized Megger 2.5 KV	Up to 1000 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
31	Earth Resistance tester (Tester)	0 to 1, 10 Ohms	± 5% at Centre Scale range
32	AC tongue Tester	0 to 1000A AC	± 3%
33	DC Tongue Tester	0 to 300A DC	± 5%
34	High Voltage test Kit	Up to 50 KV AC -50 ma capacity	± 10%
		Up to 70 KV DC	± 10%
35	DC Ammeter	0 to 300 A	
36	DC Voltmeter	0 to 500 V	
37	Micro Ohm meter	10A and 100 A	
38	Primary Injection kit	0-10000A	
39	Single Phase Variac	0-15 Amps	
40	Motor Direction tester		
41	DC Tong Tester (mA)	0-500 mA	
42	Contact Resistance Tester for Breaker contact		

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S.No.	INSTRUMENT / TOOL	RANGE	ACCURACY
	Resistance measurement		
43	Motorized Megger 5kV	10000 Mega Ohms	

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.
- 1.4.5. 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

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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

- 1.4.6. Computerized ferrules printing machine (min – 01 No.) shall be provided for making printed ferrules for all the cables.
- 1.4.7. **PROTECTION / HANDLING OF TOOLS AND PLANT ARRANGED BY THE CONTRACTOR**
- 1.4.7.1. 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.
- 1.4.7.2. 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.
- 1.4.7.3. No material or equipment or tools etc., shall be taken out of the work-site without the written consent of BHEL.
- 1.4.7.4. 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.
- 1.4.7.5. 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.
- 1.4.7.6. 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:

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- 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.

1.4.7.7.

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:

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VOLUME-IA PART – I CHAPTER – V **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.
 - 1.5.1.2. 75T or above Capacity based on requirement (Refer 1.5.9 below)
- 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. BHEL's 75T (or above) Crane is only for erection purpose of GT, Bus Duct and its auxiliaries only (if required) and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.
- 1.5.10. 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.

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- 1.5.11. BHEL may provide either BHEL owned or hired 75T (or above capacity) cranes as per site requirement for erection at the discretion of BHEL.
- 1.5.12. In the event of providing BHEL owned cranes:
 - 1.5.12.1. BHEL shall provide crane operator at free of charges.
 - 1.5.12.2. Fuel and lubricants are to be arranged by the contractor within the quoted rate.
 - 1.5.12.3. 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.
- 1.5.13. In the event of providing hired cranes:
 - 1.5.13.1. Crane Operators for hired cranes will be provided by BHEL, free of charges.
 - 1.5.13.2. Fuel and lubricants are to be arranged by the contractor within the quoted rate.
- 1.5.14. 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.
- 1.5.15. 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.

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- 1.5.16. 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.
- 1.5.17. 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.
- 1.5.18. Necessary electrical / water / air connection required for operation of any of the tools & tackles shall be in the Contractor's scope.
- 1.5.19. 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. However, bidders may note that the Hydraulic jacks that are supplied by manufacturing units for alignment of Generator Stator, if any shall be made available to TG contractor for the said purpose.
- 1.5.20. 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.
- 1.5.21. 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.
- 1.5.22. 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.
- 1.5.23. 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.

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VOLUME-IA PART – I CHAPTER-VI **TIME SCHEDULE**

1.6.1. **TIME SCHEDULE**

1.6.1.1. The entire Erection, Testing & Commissioning of Electrical and Control and Instrumentation (C&I) works as detailed in the Tender Specification shall be completed within **13 (Thirteen) months** from the date of commencement of work at site as per the below schedule.

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 and shall be deemed as completed in all respect only when the unit is in operation. 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 F15 in Volume-IA Part II for all the instructions to be taken immediately after receipt of fax LOI.

1.6.2. **COMMENCEMENT OF CONTRACT PERIOD**

Contractor has to commence the work within 10 days of issuance of LOI. In case of discrepancy in the date of commencement of contract period, the decision of BHEL engineer is final.

1.6.3. **MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIONING 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 his resources in such a manner that following major milestones of erection & commissioning are achieved on specified schedules:

A: Major MILESTONES for the project

Milestone Activity	(Completion from the commencement of contract period)
Boiler Light Up	3 rd Month
STG Rolling and Synchronization (without FGD and LHS)	7 th Month
Full Commissioning with FGD and LHS	11 th Month
Trial Operation	12 th Month

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Balance work completion, pending points, punch points liquidation	13 th Month

B: Major Intermediate Milestones (for penalty)

Activity	(Completion from the commencement of contract period)	Milestone
Boiler Light Up	3 rd Month	M1
STG Rolling and Synchronization (without FGD and LHS)	7 th Month	M2

- 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.

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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.

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**

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 **Twelve Months** shall commence from: -

1. The date of handing over of the Unit complete with FGD and LHS to Customer (or)
2. Six months from the date of first synchronization of the unit with coal firing, whichever is earlier (Provided all erection, testing, and commissioning works are completed in all respects).

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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 1.7.2.19. 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) including earthing wires	
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%

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Sl. No.	Activity/Work Description	% of unit rate
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.	DG sets / Switch Gears / MCC/ PCC / Distribution Boards / Marshalling Box / Starter Units / Electrical Hoists/ Panels/ Cubicles / Desks / UPS / Batteries / Chargers / VFD / LA assy / NGT/NGR/SP/ Circuit breaker/ Miscellaneous Equipments/ etc.	
7.1	Placement, Alignment and coupling / interconnection where ever applicable, erection of associated accessories etc	50%
7.2	Pre-commissioning checks and tests	10%
7.3	Charging, Loop testing and commissioning	15%
7.4	System commissioning	10%
	Total	85%
1.7.2.8.	Earthing / Lightning protection strips, Earthing pits	
8.1	Fabrication, erection, alignment, welding /bolting of earthing / lightning protection strips; earth pits Completion	60%
8.2	Testing / commissioning	25%
	Total	85%
1.7.2.9.	LT / HT Bus Ducts	
9.1	Pre assembly of Bus Ducts and accessories, erection, alignment, bolting/welding etc. complete with supporting structure and earthing.	50%

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Sl. No.	Activity/Work Description	% of unit rate
9.2	Pre commissioning checks	20%
9.3	Testing, Charging	10%
9.4	Final Painting	5%
1.7.2.10.	Oil Filled Transformers (GT, ST, UT , UAT, SAT & all service Transformers)	
10.1	Placement on foundation and alignment	25%
10.2	Erection of associated auxiliaries / assemblies, oil filling, earthing, including branch trays and piping work, etc.	25%
10.3	Dry out including oil filtration	15%
10.4	Pre-commissioning checks	10%
10.5	Testing, Charging	5%
10.6	Final Painting	5%
	Total	85%
1.7.2.11.	Testing / Commissioning of Equipment (like LT/HT motors, actuators, ESP transformer, misc equipment, etc) erected by other agencies.	
11.1	Local testing (Including oil filtration for ESP transformers)	40%
11.2	Remote testing, Loop testing, and commissioning	40%
11.3	System commissioning	5%
	Total	85%
1.7.2.12.	DCS/FURNITURE DESK/ RACK/ENCLOSURE/HMI/MIS System/All type of control panels	
12.1	Erection and alignment	50%
12.2	Fixing of loose items/instruments where ever applicable	5%
12.3	Pre commissioning checks, Charging of panel and Loop testing etc	15%
12.4	System commissioning	15%
		85%
1.7.2.13.	UPS/Battery Charger/Battery/ACDB	
13.1	Erection and alignment	50%
13.2	Fixing of loose supplied items/instruments where ever required	5%
13.3	Pre commissioning checks, Charging of panel and Loop testing and pouring of electrolytes	15%
13.4	System commissioning	15%
	Total	85%
1.7.2.14.	For all types of Instruments/Devices/Sensors/Cells/Probes, etc.	
14.1	Calibration/Testing/Pre erection checks	30%

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Sl. No.	Activity/Work Description	% of unit rate
14.2	Erection/Placement and fixing of loose items/accessories	30%
14.3	Pre commissioning checks/loop testing/Simulation testing as required	10%
14.4	Remote/local commissioning as required	15%
	Total =	85%
1.7.2.15.	Testing/Commissioning of Equipment erected by other agencies	
15.1	Removal & refixing/Fixing of loose supplied components of instruments, (including tubing/hose, regulators, etc)	30%
15.2	Calibration/Local testing - commissioning readiness	30%
15.3	Local Commissioning & Loop Testing as required	10%
15.4	System Commissioning or Remote Commissioning	15%
	Total =	85%
1.7.2.16.	Power Cylinders	
16.1	Erection and alignment of Power Cylinders	30%
16.2	Fixing of loose supplied items	30%
16.3	Loop Checking, Calibration and Local commissioning	20%
16.4	System/Remote commissioning	5%
	Total =	85%
1.7.2.17.	Miscellaneous Electrical Items	
17.1	Rubber mats / Display Boards / Miscellaneous items / etc : on installation	85%
17.2	Specialized Commissioning Services - on pro rata basis.	85%
17.3	Civil Works / structural works - Prorata on completion of actual work.	85%
17.4	Earthing of steel columns of Boiler, ESP, PH structures and any other structure columns	85%
17.5	Termination, HT Termination, Straight through jointing etc : on pro rata basis	85%
1.7.2.18.	Other Items (Items not covered under above heads)	
18.1	Erection	50%
18.2	Alignment	10%
18.3	Testing	15%
18.4	Completion of Commissioning of the respective item/equipment	10%
	Total =	85%

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Sl. No.	Activity/Work Description	% of unit rate
1.7.2.19.	For Supply Items(if applicable)	
19.1	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**.

II	STAGE / MILESTONE PAYMENTS (15%)	% of unit rate
1.7.3.1.	Boiler Light Up	1%
1.7.3.2.	ABO/Chemical/EDTA cleaning	1%
1.7.3.3.	Safety Valve floating (Electromatic Relief Valves)	1%
1.7.3.4.	Rolling and Synchronization	2%
1.7.3.5.	Full Commissioning with FGD and LHS	1%
1.7.3.6.	Full Load	2%
1.7.3.7.	Trial Operation of Unit	2%
1.7.3.8.	Area cleaning, temp structure cutting/ removal and return of scrap	1%
1.7.3.9.	Punch List points / pending points liquidation	1%
1.7.3.10.	Submission of 'As Built Drawings'	1%
1.7.3.11.	Monthly Material Reconciliation	1%
1.7.3.12.	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. **For Illumination Items**

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

1.7.5.1.	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 1.7.5.1.1 to 1.7.5.1.6 of the following table	
1.7.5.1.1.	Light Poles, fittings & Accessories	
a.	Erection of Light Poles, fittings & Accessories	70%
b.	Final painting	15%

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	Total=	85%
1.7.5.1.2.	Masts, fittings & Accessories	
a.	Erection of Masts, fittings & Accessories	85%
	Total=	85%
1.7.5.1.3.	GI/Flexible Conduits, fittings & wires	
a.	Fixing of GI/Flexible conduits with fittings	60%
b.	Pulling & termination of wires and Earth wires	25%
	Total=	85%
1.7.5.1.4.	Lighting Luminaires, Fans, Emergency Lighting Units, Exit Signs	
a.	Fixing of Lighting Luminaires, Fans, Emergency Lighting Units, Exit Signs	70%
b.	Charging of Lighting Luminaires, Fans, Emergency Lighting Units, Exit Signs	15%
	Total=	85%
1.7.5.1.5.	Lighting Distribution Boards (LDB)/ Lighting Transformers/ Lighting Panels (LP)/ Switch Boxes (SB)/ Junction Boxes (JB)/ 24 V Lighting Modules/ Receptacles & Miscellaneous equipment	
a.	Erection of LDBs / LPs / SBs / JBs / 24 V Lighting Modules/Receptacles & Miscellaneous equipment	70%
b.	Charging of LDBs / LPs / SBs / JBs / 24 V Lighting Modules/Receptacles & Miscellaneous equipment	15%
	Total=	85%
1.7.5.1.6.	Misc. Structural steel including JB Supports, Panel Supports, J-Poles , etc.	
a.	Fabrication / Pre assembly	45%
b.	Erection, Alignment, welding/bolting and if applicable chipping/grouting/painting	40%
	Total =	85%
1.7.5.2.	STAGE / MILESTONE PAYMENTS (15%)	
a.	On completion of commissioning, 10% of the item rate will be released on prorata basis.	10%
b.	Further 5 % of the item rate will be released on pro rata basis on successful demonstration. (Note: this payment will be clubbed with commissioning and released wherever not applicable.)	5%

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- 1.7.6. **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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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.

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- 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.

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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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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.

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- 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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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 shall 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART – I CHAPTER IX

WEIGHT SCHEDULE/BOQ

1.9.1. BOQ

SL NO.	ITEM DESCRIPTION	UOM	QTY
A	BHEL BHOPAL SCOPE OF SUPPLY		
A.1	11kV, HT isolation panel/Switchboard, Indoor, Metal Clad (VM-12) type, Vacuum Break Switch, incomer-outgoing feeders with Bus PT along with associated loose supplied items; SWBD consists of 2 panels of suitable shipping section. Overall panel sizes 1640 (L) x2927 (D) x2800 (H). Approximate weight- 3000 kg	Set	4
B	BHEL JHANSI SCOPE OF SUPPLY		
B.1	25/ 18.5 MVA 11.5/11 KV 3 phase ONAN cooled, YNd1, Generator Transformer, Outdoor with On Load Tap Changers (OLTC), HV/ HVN/ LV post insulators, neutral bushings, bushing CTs, Turrets, Conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories. Approximate Dimensions of each transformer (l x b x h): Approx. Overall Dimensions: 8600(L) x 6800(B) x 5850(H). Shipping Dimension of Largest package: 4700(L) x 3650(B) x 4000(H). Weight of heaviest package - 36300kg approx. Weight of core and winding assembly- 26700 kg approx; Weight of tank, fittings and accessories – 26140 kg approx; Total weight of transformer-72440 kg approx; Transformer Oil Qty -19600 Ltrs approx. * Please refer TCC for scope and other details. Lump sum rate to be quoted for Erection, Testing, Commissioning including final painting.	Set	1
B.2	2000 KVA 11/0.433 KV 3 phase, AN cooled/ Dyn11, Cast Resin Dry Type Transformer, Indoor with HV/LV/LVN Bushings, Off Circuit Bolted links type of Tap Changers, Marshalling box; Approximate Shipping Dimensions: 2800(L) x2275(B) x2750(H) ,Weight of Shipment: 7000kg approx each.	Set	2
B.3	1600 KVA 11/0.433 KV 3 phase, AN cooled/ Dyn11, Cast Resin Dry Type Transformer, Indoor with HV/LV/LVN Bushings, Off Circuit Bolted links type of Tap Changers, Marshalling box; Approximate Shipping Dimensions (in	Set	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
	mm): 2800(L) x2275(W) x2750(H) Weight of Shipment: 6000kg approx each.		
B.4	Commissioning of the following erected by Mechanical contractor		
B.4.1	High Voltage Rectifier (HVR) Transformers- 95 kVp, 1000 mA, having 640 Litres of Mineral oil. The scope of work includes oil filtration, sample testing for dielectric strength, PPM, etc. Calibration of WTI, Buchholtz Relay etc including oil top up if required. alongwith disconnecting switches	Set	14
C	BHEL HPEP SCOPE OF SUPPLY		
C.1	Generator Control Panel- Approx Size (in mm): 2000(L)x1000(W)x2400(H), Weight- 1500 kg approx.	Nos	1
C.2	Generator Protection Relay Panel- Approx Size (in mm): 1300(L)x800(W)x2400(H), Weight- 1500 kg approx	Set	1
C.3	TVM cubicle- Approx Size (in mm): 1000 (L)x500x1600(H), Weight- 500 kg approx including Removal, Calibration and Fixing of instruments	Set	1
C.4	CO2 Fire Extinguishing Equipment Control Panel - Approx Size (in mm): 800(L)x800(W)x2400(H), Weight- 500 kg approx	Set	1
C.5	Control Cables		
C.5.1	3C x 2.5 Sq.mm	Mtrs	1500
C.5.2	5C x 2.5 Sq.mm	Mtrs	1000
C.5.3	10 C x 2.5 Sq.mm	Mtrs	1000
C.5.4	10T x 0.5 Sq.mm	Mtrs	1000
C.5.5	3 C x 6 Sq.mm	Mtrs	800
C.5.6	3 C x 4 Sq.mm	Mtrs	800
C.6	Commissioning of the following erected by Mechanical contractor		
C.6.1	Generator 18.5 MW - H.V. testing, meggering of Bushings & Accessories, resistance measurement, meggering including dry out of Generator and as per field quality plan. The scope of work includes measuring IR Value, HV Test for Generator Bushing, improving IR value, measuring winding resistance etc.	Set	1
C.6.2	LT Motors	Nos	7
C.7	Local Instrument Enclosures/Racks/Gauge Board		
C.7.1	Local Gauge Board 2000X1700 (WxH), 400 kg	Set	1
C.7.2	Governing console Board 1200X1900 (WxH), 400 kg	Set	1
C.7.3	Local Gauge Board Assembly of approximate Size: 1900 x 550 x 1600 mm; Weight = 300 kg	Set	4
C.7.4	LIR Assembly of approximate Size 2000 x 650 x 2150 mm Weight = 200 kg	Set	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
C.8	Calibration, Erection, Testing and Commissioning of Field Instruments		
C.8.1	Pressure Gauge	Nos	10
C.8.2	Thermocouple	Nos	4
C.8.3	Noise level transmitter (MICROPHONE And Transmitter)	Nos	2
C.8.4	Pressure Switch	Nos	10
C.8.5	Float Switch	Nos	2
C.9	Commissioning of the following erected by Mechanical contractor		
C.9.1	Mills Support Bearing Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Approximate instruments per Set: Temp.Gauges-03 Nos., DP Switch- 02 Nos., DP Indicator-02 Nos., Pressure Gauge-3 Nos., Pressure Switches- 07 Nos., LT Drives-6 Nos., etc.Checking of Wiring from skid Junction Box to Instruments.	Set	2
C.9.2	Mills Main Reducer Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Approximate instruments per Set: Temperature Switches-02 Nos., Temp.Gauges-02 Nos., Pressure Gauge-2 Nos., LT Drives-2 Nos, Flow Indicators-2 Nos., Solenoid Valve- 1No. etc. Checking of wiring from skid Junction Box to Instruments	Set	2
C.9.3	Girth Gear Sealing System:- Removal, Calibration and re-fixing of following instruments, Approx. instrument per set, Pressure Gauge-3 Nos., Pressure Switch- 1 No., Limit Switch- 01 No., Level Switch-1 No., LT Drives-1 No., etc. Checking of wiring from skid Junction Box to Instruments.	Set	2
C.9.4	Hydraulic Coupling of MDBFP: The scope of work convers a) Removal, calibration & refixing of following instruments approximately: Pressure Indicators: 2 Nos. DP Indicator: 2 Nos., Temperature Indicators: 10 Nos., Level Gauge-1No., Level Switch-1No.,RTDs (Checking only): 8 Nos., etc. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. c) Commissioning of Speed Indicators etc.	Set	2
C.9.5	Limit switches	Nos	8
C.9.6	Control Valves (with smart positioner, position transmitter)	Set	5
C.10	Erection and Commissioning of Delta P Level control panel Removal, Calibration and re-fixing of following instruments, Approximate instruments per set: Pressure Switches- 2 Nos., Diff. Pressure Transmitter- 2 Nos.,	Set	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
	Solenoid valves- 7 Nos, etc. Checking of wiring from skid Junction Box to Instruments.		
C.11	Solenoid Valves	No	1
C.12	Bearing Thermo Elements (RTD 3 WIRE PT-100)	Nos	24
C.13	Speed probes	Nos	7
C.14	Impulse Pipe dia 21.3 x 2.8	Mtrs	100
C.15	Erection and Commissining of Girth Gear Control Panel of Size: 600mm X 400mm X 210mm	Set	2
C.16	Loop checking of various instruments of Generator, Turbine	Nos.	22
D	BHEL PESD SCOPE OF SUPPLY		
D.1	DC System-1 (For STG Area)		
D.1.1	VRLA 110V Battery for DC System-1: This is a Battery of approx. 2400 Ah and roughly 110 Cells. Each Battery Bank consists of two nos. of 1200Ah(approx.) battery bank connected in parallel. Dimension of each Battery Bank is approx. LxBxH (mm)- 4000x725x1800 for 1 no. of 1200Ah battery, Approx. Weight (each) KG- 5200 kg for 1 no. of 1200Ah battery. Each Battery Bank consists of individual/multiple interconnected cell modules, tie brace, front cover, top cover made of Rigid PVC/PC, fixing of bolts, applying of petroleum jelly, etc.	Set	2
D.1.2	110V, 650A Battery Charger. Each set consist of FC + FCBC charger, Dimension (each) LxBxH (mm)- 4000x1000x2200, Weight- 3050 kg	Sets	2
D.1.3	Battery Isolation Box (650A) Dimension (each) LxBxH (mm)- 700x350x1000, Weight- 95 kg	Set	1
D.2	DC System-2 (Ammonia Storage Area)		
D.2.1	VRLA 110V Battery for DC System-2: This is a Battery of approx. 100 Ah and roughly 55 Cells. Overall dimensions approx. is LxBxH (mm)- 800x500x1300mm, Weight- 600 kg	Sets	2
D.2.2	110V, 50A Battery Charger. Each set consist of FC + FCBC charger, Dimension (each) LxBxH (mm)- 1200x600x2200, Weight- 450 kg	Sets	2
D.2.3	Battery Isolation Box (50A) Dimension (each) LxBxH (mm)- 500x300x800, Weight- 35 kg	Sets	2
D.3	UPS SYSTEM FOR ILLUMINATION PURPOSE		
D.3.1	415V, 2 X30 KVA/40KVA UPS parallel redundant comprising of the following tentatively : UPS-1 , UPS 2, Rectifier Panels, Inverter panels, Input Iso. Transformer	Set	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
	& SCVS panels. Over all size approx. LxBxH (mm)- 2400x800x2200, Weight- 1200 kg		
D.3.2	Battery for 30 KVA/40KVA UPS:160 AH/ 12V VRLA Battery: Consists of approx. 34 blocks each of approx. dimension 445 x 168 x 283 mm and weight 52 kg,. Overall Battery Bank Dimension (each) LxBxH (mm)- 3000x500x1500 and overall Weight- 2200 kg	Set	2
D.3.3	Battery Isolation Box in Illumination System Dimension (each) LxBxH (mm)- 600x400x800, Weight- 30 kg	Set	2
D.4	11 kV Neutral Ground Resistor (NGR) with Isolator and supporting structures. Approx. dimensions (in mm)- 2000 (L) X 800 (W) X 1400 (H) of weight approx. 1200 kg. and erection of Fabricated support structure 1 metre high, made of MS angles, (Bolted type), Hot Dip Galvanised	Set	1
D.5	HT Power Cable		
D.5.1	11KV(UE) 1CX500 AI ARM PVC/FRLS CABLE	Mtrs	3600
D.5.2	11KV(UE) 3CX185 AI ARM PVC/FRLS CABLE	Mtrs	3050
D.5.3	6.6KV(UE) 3CX185 AI ARM PVC/FRLS CABLE	Mtrs	3000
D.6	HT Power Cable Termination Kits		
D.6.1	11KV(UE) 1CX500 Terminating Kit	Nos	45
D.6.2	11KV(UE) 3CX185 Terminating Kit	Nos	20
D.6.3	6.6KV(UE) 3CX185 Terminating Kit	Nos	45
D.7	HT Power Cable Straight Through Joint Kits		
D.7.1	11KV(UE) 3CX185 Straight through Joint	Nos	2
D.8	Laying of LT Power Cable		
D.8.1	1CX10 CU XLPE UNARM	Mtrs	2000
D.8.2	1CX35 CU XLPE UNARM	Mtrs	1500
D.8.3	1CX120 CU XLPE UNARM	Mtrs	1500
D.8.4	1CX25 Cu FLEXIBLE UNARM	Mtrs	500
D.8.5	1CX35 AL XLPE UNARM	Mtrs	2,100
D.8.6	1CX630 AI XLPE	Mtrs	14250
D.8.7	2CX2.5 Cu XLPE	Mtrs	60000
D.8.8	2CX6 AI XLPE	Mtrs	5400
D.8.9	2CX10 AI XLPE	Mtrs	2000
D.8.10	2CX16 AI XLPE	Mtrs	5100
D.8.11	2CX35 AI XLPE	Mtrs	800
D.8.12	2CX120 AI XLPE	Mtrs	3400
D.8.13	3CX2.5 Cu XLPE	Mtrs	158000
D.8.14	3CX6 AI XLPE	Mtrs	9000
D.8.15	3CX10 AI XLPE	Mtrs	7200
D.8.16	3CX16 AI XLPE	Mtrs	7200
D.8.17	3CX25 AI XLPE	Mtrs	3300
D.8.18	3CX50 AI XLPE	Mtrs	1400

Tender Specification No.: BHEL: PSSR: SCT: 2213

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SL NO.	ITEM DESCRIPTION	UOM	QTY
D.8.19	3CX150 AI XLPE	Mtrs	500
D.8.20	3.5CX35 AI XLPE	Mtrs	3600
D.8.21	3.5CX70 AI XLPE	Mtrs	1000
D.8.22	3.5CX95 AI XLPE	Mtrs	2700
D.8.23	3.5CX185 AI XLPE	Mtrs	1200
D.8.24	3.5CX240 AI XLPE	Mtrs	2300
D.8.25	4CX2.5 Cu XLPE	Mtrs	5800
D.8.26	4CX4 Cu XLPE	Mtrs	1000
D.8.27	4CX6 AI XLPE	Mtrs	4900
D.8.28	4CX10 AI XLPE	Mtrs	2700
D.8.29	4CX16 AI XLPE	Mtrs	13300
D.8.30	4CX25 AI XLPE	Mtrs	11100
D.8.31	4CX35 AI XLPE	Mtrs	3500
D.8.32	4CX185 AI XLPE	Mtrs	2300
D.9	End Termination of LT Power Cable		
D.9.1	1CX10 CU XLPE UNARM	Nos	10
D.9.2	1CX35 CU XLPE UNARM	Nos	10
D.9.3	1CX120 CU XLPE UNARM	Nos	10
D.9.4	1CX25 CU XLPE UNARM	Nos	6
D.9.5	1CX35 AL XLPE UNARM	Nos	14
D.9.6	1CX630 AI XLPE	Nos	100
D.9.7	2CX6 AI XLPE	Nos	36
D.9.8	2CX10 AI XLPE	Nos	10
D.9.9	2CX16 AI XLPE	Nos	34
D.9.10	2CX35 AI XLPE	Nos	10
D.9.11	2CX120 AI XLPE	Nos	20
D.9.12	3CX6 AI XLPE	Nos	60
D.9.13	3CX10 AI XLPE	Nos	48
D.9.14	3CX16 AI XLPE	Nos	48
D.9.15	3CX25 AI XLPE	Nos	22
D.9.16	3CX50 AI XLPE	Nos	10
D.9.17	Void	Nos	0
D.9.18	3.5CX35 AI XLPE	Nos	24
D.9.19	3.5CX70 AI XLPE	Nos	10
D.9.20	3.5CX95 AI XLPE	Nos	18
D.9.21	3.5CX185 AI XLPE	Nos	8
D.9.22	3.5CX240 AI XLPE	Nos	20
D.9.23	4CX4 Cu XLPE	Nos	10
D.9.24	4CX6 AI XLPE	Nos	30
D.9.25	4CX10 AI XLPE	Nos	18
D.9.26	4CX16 AI XLPE	Nos	90
D.9.27	4CX25 AI XLPE	Nos	74
D.9.28	4CX35 AI XLPE	Nos	20

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SL NO.	ITEM DESCRIPTION	UOM	QTY
D.9.29	4CX185 Al XLPE	Nos	20
D.10	GI Cable trays and accessories):		
D.10.1	Ladder type cable tray, W=600mm, without cover	Mtrs	8325
D.10.2	Ladder type cable tray, W=600mm, with cover	Mtrs	525
D.10.3	Ladder type cable tray, W=300mm, without cover	Mtrs	5275
D.10.4	Ladder type cable tray, W=300mm, with cover	Mtrs	213
D.11	Plant Earthing Plant Lightning Protection Materials		
D.11.1	75x10mm GI Strip	Mtrs	5500
D.11.2	50 x 6 mm GI Strip	Mtrs	9400
D.11.3	35 x 6mm GI Strips	Mtrs	1700
D.11.4	25 x 6 mm GI Strips	Mtrs	4800
D.11.5	25 x 3mm GI Strips	Mtrs	4700
D.11.6	6SQ.MM Stranded G.I wire	Mtrs	43000
D.11.7	16SQ.MM Stranded G.I wire	Mtrs	12000
D.11.8	Treated Earth pit of Copper pipe 3000 m long with funnel and accessories including all civil works, filling of earth pit with alternate layer of chrcoal & salt as per IE specification and making of brick /PCC 1:2:4 chamber, with both side plastering, supply and fising of manhole CI cover plate/RCC Slab etc. complete as per IS 3043 (only Copper Pipe Electrode pipe shall be supplied by BHEL)	Nos	25
D.11.9	Treated Earth pit of CI pipe 4200 m long with funnel and accessories including all civil works, filling of earth pit with alternate layer of chrcoal & salt as per IE specification and making of brick chamber, with both side plastering, supply and fising of manhole CI cover plate/RCC Slab etc. complete as per IS 3043 (only 100 mm CI pipe shall be supplied by BHEL)	Nos	60
D.11.10	32 mm dia GI rod long 1400 mm vertical air termination, along with 50mm solid GI Sphere, 3nos. 150mm long 6mm base dia solid GI Conical Spikes inclined at an angle of 30 deg to the vertical, equally spaced and screwed to the GI Sphere with 300x50x10 GI Base Plate, 50X6 GI Flat Supports and related accessories	Set	25
D.12	Structural Steel (Channels, Angles, etc.)	MT	161
D.13	Void		
D.14	Void		
D.15	Commissioning of the following erected by Mechanical agency		
D.15.1	LT Drives	Nos	18
D.16	Erection, Alignment, Testing and Commissioning of Panels		
D.16.1	PLC panel for LDO/ HFO. Dim (LxWxH) 2400 (L)x800(W)x2115(H), weight- 2000 kg	Set	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
D.16.2	Power Distribution Board. Dim (LxWxH)- 800mmx300mmx800mm, weight- 1000 kg	Set	1
D.17	Calibration, Erection, Testing and Commissioning of Field Instruments		
D.17.1	Flow Elements	Nos	24
D.17.2	Level Gauges	Nos	22
D.17.3	Level Transmitter(Guided wave Radar)	Nos	14
D.17.4	Rotameter	Nos	2
D.17.5	Pressure Gauge	Nos	227
D.17.6	Pressure Gauge-Diaphragm Seal	Nos	28
D.17.7	Differential pressure Gauge	Nos	18
D.17.8	Pressure Transmitters (HART)	Nos	200
D.17.9	Remote seal Pressure Transmitter	Nos	18
D.17.10	Differential Pressure Transmitter	Nos	136
D.17.11	Remote Seal Differential Transmitter	Nos	10
D.17.12	Temperature Element (RTD & T/C) with Thermowell	Nos	190
D.17.13	Temperature Gauges with Thermowell(Screw type)	Nos	280
D.17.14	Temperature Transmitters (HART)	Nos	221
D.17.15	Pressure Switch	Nos	55
D.17.16	Differential Pressure Switch	Nos	7
D.17.17	Void		
D.17.18	Void		
D.17.19	Vibration Sensor/Transducer	Nos	1
D.18	STEAM AND WATER ANALYSIS (SWAS): 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.		
D.18.1	SWAS ANALYSER comprising of the following: Wet panel rack of approx. size and weight 3800X600X2100, 1350 kg Dry panel rack of approx. size and weight 2400X700X2100, 1200 kg Chiller Unit PH Analysers : 10 Nos Cation Conductivity Analysers: 2 Nos Dissolved oxygen Analyser: 3 Nos Silica analyser: 4 Nos Na Analyser: 1 No. Chloride Analysers: 2 Nos 3. Special cables for sensors between wet and dry panel approx. 500mtrs, 4. Laying and termination of Power Cables to SWAS Panel and Chiller approx. 50 mtrs	Set	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
D.19	Junction Box including canopies		
D.19.1	12 WAY FP/ WP JUNCTION BOX	Nos	40
D.19.2	24 WAY FP/ WP JUNCTION BOX	Nos	49
D.19.3	48 WAY FP/ WP JUNCTION BOX	Nos	178
D.20	Pipes, Tubes for Instrument installation		
D.20.1	TUBE (SMLS), SS 316L, 1/2" OD X 2.1 mm	Mtrs	2964
D.20.2	TUBE (SMLS), SS 316L, 8 mm OD X 1 mm	Mtrs	990
D.20.3	PIPE (SMLS), A 106 Gr B, 1/2" SCH 80	Mtrs	3621
D.20.4	PIPE (SMLS), A 106 Gr B, 1/2" SCH 80	Mtrs	2225
D.20.5	PIPE (SMLS), A 106 Gr C, 1/2" SCH 80	Mtrs	964
D.20.6	PIPE (SMLS), A 106 Gr B, 1/2" SCH 160	Mtrs	106
D.20.7	PIPE (SMLS), A 335 Gr P11, 1/2" SCH 80	Mtrs	594
D.20.8	PIPE (SMLS), A 335 Gr P22, 1/2" SCH 80	Mtrs	590
D.20.9	PIPE, IS 1239, 2" SCH HVY	Mtrs	921
D.20.10	2" SCH 40, MS, Pipe	Mtrs	152
D.21	Structural Steel Materials (like ISMC Channel, Plate, MS Angles, etc.)	MT	24
D.22	Laying and Termination of Control/ Instrumentation Cables		
D.22.1	1Px1mm2 FRLS FRLS PVC/FRLS PVC OS	Mtrs	49685
D.22.2	1Px1.5mm2 FRLS PVC/FRLS PVC OS	Mtrs	37145
D.22.3	1Px1mm2 FRLS PVC/FRLS PVC OS (HR)	Mtrs	1045
D.22.4	1Px1.5mm2 FRLS PVC/FRLS PVC OS(HR)	Mtrs	1045
D.22.5	4Px1mm2 FRLS PVC/FRLS PVC OS	Mtrs	65455
D.22.6	6Px1.5mm2 FRLS PVC/FRLS PVC OS	Mtrs	5225
D.22.7	12Px1.5mm2 FRLS PVC/FRLS PVC OS	Mtrs	9405
D.22.8	10Tx1.5mm2 FRLS PVC/FRLS PVC I&OS	Mtrs	2090
D.22.9	2Px0.5mm2 FRLS PVC/FRLS PVC I&OS	Mtrs	1045
D.22.10	2Px1mm2 FRLS PVC/FRLS PVC I&OS	Mtrs	523
D.22.11	8Px1mm2 FRLS PVC/FRLS PVC OS	Mtrs	50445
D.22.12	6P x 1.0 mm2 FRLS PVC/FRLS PVC OS	Mtrs	2090
D.22.13	12Px1mm2 FRLS PVC/FRLS PVC I&OS	Mtrs	19143
D.22.14	1Tx1.5mm2 FRLS PVC/FRLS PVC OS	Mtrs	5225
D.22.15	8Tx1.5mm2 FRLS PVC/FRLS PVC I&OS	Mtrs	7220
D.22.16	1P x 16 AWG	Mtrs	2613
D.23	Control Cables		
D.23.1	3Cx1.5 sqmm Cu PVC PVC/FRLS	Mtrs	4000
D.23.2	5Cx1.5 sqmm Cu PVC PVC/FRLS	Mtrs	5200
D.23.3	7Cx1.5 sqmm Cu PVC PVC/FRLS	Mtrs	60000
D.23.4	10Cx1.5 sqmm Cu PVC PVC/FRLS	Mtrs	17000
D.23.5	12Cx1.5 sqmm Cu PVC PVC/FRLS	Mtrs	2000
D.23.6	3Cx2.5 sqmm Cu PVC PVC/FRLS	Mtrs	10000
D.23.7	7Cx2.5 sqmm Cu PVC PVC/FRLS	Mtrs	15500

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
D.24	GI Cable trays and accessories):		
D.24.1	600mm (W) Perforated type cable tray, without cover	Mtrs	550
D.24.2	600mm (W) Perforated type cable tray, with cover	Mtrs	1750
D.24.3	300mm(W) Perforated type cable tray without cover	Mtrs	2175
D.24.4	300mm (W) Perforated type cable tray with cover	Mtrs	1175
D.24.5	150mm (W) Perforated type cable tray without cover	Mtrs	1500
D.24.6	150mm (W) Perforated type cable tray with cover	Mtrs	4000
D.24.7	50mm(W) Perforated type cable tray without cover	Mtrs	1000
D.24.8	50mm(W) Perforated type cable tray with cover	Mtrs	2750
D.25	Lighting Luminaires (complete with accessories including fixing of lighting lamps)		
D.25.1	Surface mounted LED Bulkhead fixture (10-15W approx) suitable for 240V AC supply	Nos	30
D.25.2	Recess mounted LED Down light (12W approx) suitable for 110V DC supply	Nos	30
D.25.3	Surface mounted 10-15W LED Bulkhead fixture suitable for 110V DC supply	Nos	85
D.25.4	Flame proof DC LED Well Glass fixture (35W approx) suitable for DC Supply	Nos	4
D.25.5	Industrial type general purpose LED Batten with 2 nos. (18-22W approx,230V AC) LED tube lamp.	Nos	400
D.25.6	600x 600mm Recess mounted decorative LED fixture (33-36WApprox, 230V AC) with high efficiency low glare optics.	Nos	575
D.25.7	Industrial corrosion resistant type fixture of polycarbonate body with 2 nos. (18-22W approx,230V AC) LED tube lamp.	Nos	45
D.25.8	LED Well Glass fixture (35-50WApprox, 230VAC)	Nos	1700
D.25.9	LED medium bay fixture (80-100WApprox, 230VAC)	Nos	100
D.25.10	LED high bay fixture (150-180WApprox, 230VAC)	Nos	100
D.25.11	Flame proof LED Well Glass fixture (35-50WApprox, 230VAC)	Nos	22
D.25.12	LED street lighting fixture (60W approx, 230V AC)	Nos	90
D.25.13	LED Flood lighting Fixture (90 watt approx)	Nos	75
D.25.14	Flame proof LED Street lighting fixture (60WApprox, 230VAC)	Nos	5
D.25.15	LED Flame proof Flood lighting Fixture (180-200 watt approx)	Nos	5
D.26	Poles		
D.26.1	11meter Steel tubular pole along with Junction Box all accessories including PCC foundation (except LED fixture and 3C-2.5sqmm cable)	Nos	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
D.26.2	4.75 meter 50NB GI pole along with Junction Box of approx. dimensions 200X150X100mm with MCB	Nos	10
D.26.3	3 meter 50NB GI pole along with Junction Box of approx. dimensions 200X150X100mm with MCB	Nos	638
D.27	Conduit including laying of Wires		
D.27.1	Void		
D.27.2	Void		
D.27.3	50NB GI conduit	Mtrs	60
D.27.4	50NB PVC conduit	Mtrs	45
D.27.5	20mm GI conduit	Mtrs	900
D.27.6	25mm PVC conduit	Mtrs	14040
D.28	Junction Boxes		
D.28.1	4 way 250x200x120mm rectangular sheet steel weather proof JB (IP55)	Nos	50
D.28.2	MCB Box with 20A MCB	Nos	190
D.28.3	FLP DC MCB Box with 10A DC MCB	Nos	2
D.28.4	Switchboard (Flush/Surface mount type) with 2/3nos. 6A Piano type switch	Nos	100
D.28.5	Decorative type 6/16A receptacle with 16A switch (Flush/Surface mounted, modular type)	Nos	125
D.28.6	Industrial metal clad type 1Ph, 20A Socket with 20A interlocked rotary switch & Plug	Nos	130
D.28.7	Flameproof 1ph, 20A Socket with interlocked rotary switch & Plug	Nos	3
D.28.8	Industrial metal clad type 3Ph, 63A (5pin) receptacle with interlocked rotary switch & Plug	Nos	50
D.28.9	Void		
D.29	Lighting Panels (LP)		
D.29.1	18 way AC Indoor Lighting Panel	Nos	2
D.29.2	12 way AC Indoor Lighting Panel	Nos	14
D.29.3	6 way AC Indoor Lighting Panel	Nos	42
D.29.4	6 way DC indoor Lighting Panel	Nos	10
D.29.5	18 way AC Outdoor Lighting Panel	Nos	7
D.29.6	12 way AC Outdoor Lighting Panel	Nos	8
D.29.7	6 way AC Outdoor Lighting Panel	Nos	14
D.29.8	Flame proof 12 way AC Lighting Panel	Nos	1
D.29.9	Flame proof 6 way AC Lighting Panel	Nos	2
D.30	Wires (Payment for laying of these wires in conduits is included in laying of Conduits)		
D.30.1	1Cx 1.5 Sqmm Cu. Multi strand PVC Flexible wire (Green)	Mtrs	28260
D.30.2	1Cx 2.5 Sqmm Cu. Multi strand PVC Flexible wire (Red, Yellow, Blue and black)	Mtrs	52920

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
D.31	Lighting transformers		
D.31.1	75 kVA Normal Lighting transformers	Nos	2
E	BHEL RANIPET SCOPE OF SUPPLY		
E.1	LT Switch Boards		
E.1.1	LT SWITCH BOARD/ESP SWITCHGEAR. Approx dimension (in mm)- 11450 (L) X 1300 (D) X 2450 (H), weight- 7300 kg approx.	Set	1
E.1.2	AUXILIARY CONTROL PANEL. Approx dimension (in mm)- 11750 (L) X 1300 (D) X 2450 (H), weight- 13500 kg approx.	Set	2
E.2	Control Panels		
E.2.1	EC PANEL. Approx dimension (in mm)- 600 (L) X 550 (D) X 2000 (H), approx. weight- 250 kg along with loose items ARECA Controllers, firing cards, interfacing cables, RF Communication modules and Cutout plates	Set	14
E.3	LT Armoured Aluminium Conductor Power Cables		
E.3.1	3.5C-300 SQMM AL ARMOURED	Mtrs	1000
E.3.2	2C-120 SQMM AL ARMOURED	Mtrs	6400
E.3.3	3C-35 SQMM AL ARMOURED	Mtrs	500
E.3.4	3C-16 SQMM AL ARMOURED	Mtrs	5500
E.4	LT Armoured Copper Conductor Cables		
E.4.1	3C-2.5 SQMM CU ARMOURED	Mtrs	5500
E.4.2	2C-2.5 SQMM CU ARMOURED	Mtrs	6500
E.5	LT Armoured Cables		
E.5.1	3C-1.5 SQMM CU ARMOURED	Mtrs	7500
E.6	End Terminations		
E.6.1	3.5C-300 SQMM AL ARMOURED	Nos	6
E.6.2	2C-120 SQMM AL ARMOURED	Nos	42
E.6.3	3C-35 SQMM AL ARMOURED	Nos	2
E.6.4	3C-16 SQMM AL ARMOURED	Nos	36
E.7	E&C of Miscellaneous Items		
E.7.1	Local Start Stop Pushbuttons for Rapping Motors	Nos	30
E.7.2	Junction boxes for Hopper/Support Insulator/Shaft Insulator Heaters/Pushbuttons/Thermostats	Nos	50
E.7.3	Data Logger System consists of Industrial Grade Computer (01 No.), 24" Colour monitor LCD (01 No.), Keyboard(01 No.), Colour Laser Jet Printer (01 No.), Power Supply Cable (01 No.), Centronix Cable/USB cable (01 No.)	Set	1
E.7.4	IOS system consists of Industrial Grade Computer (01 No.), 24" TFT LCD colour monitor (01 Nos), Keyboard(01 No.), Opto Isolated RS485 communication card (01 No.), Opto Isolated USB to RS485 converter (01 No.) and IOS module box (01 No.) along with loose items analog Input	Set	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
	module (01 No.), Digital Input modules (01 No.) and Serial Device Server (01 No.)		
E.7.5	Ash Level Indicators along with probe head assembly, Sensor Processor units (JB), probe mounting sockets, shielded cables (approx. 20 mtrs), GI flexible metallic conduits (approx. 20 mtrs), 1 sqmmPVC insulated cable(approx. 20m), saddles, mounting fasteners,etc.	Set	56
E.8	Commissioning of the following (erected by other contractor)		
E.8.1	11KV HT Motors	Nos	7
E.8.2	LT Motors	Nos	264
E.8.3	Void		
E.8.4	Geared Motors-of 0.5 kW (EE/CE/GD) for rapping system	Nos	30
E.8.5	Electrically Operated Hoist	Nos	2
E.8.6	Heating Elements for Hoppers/ Shaft Insulators/ Support Insulators	Nos	98
E.8.7	Thermostats for Hopper & Support Insulators	Nos	16
E.8.8	Interlock ESP panels/ fields - with master keys	Set	6
E.8.9	Auxiliary Motor and Main Motor for Ball Mill	Nos	4
E.8.10	Geared Motor for Agitator Assembly in Ball Mill System	Nos	2
E.8.11	VFD Compatible Motor for Mill Recirculation Slurry Pump in Ball Mill System	Nos	2
E.8.12	VFD for Slurry Pump in Ball Mill System	Nos	2
E.9	Control and Instrumentation Cables		
E.9.1	4P X1.5 SQ.MM (G-TYPE)	Mtrs	4000
E.9.2	10C-1.5 SQMM CU ARMOURED	Mtrs	6300
E.10	Commissioning of the following erected by mechanical contractor		
E.10.1	Lub Oil Skids for Air Preheater: The scope of work includes removal of instruments, calibration, refixing, checking cable connection from JB to instruments etc. The approx.. Quantity of instruments for each skids given below: Pressure Gauges-2 Nos. Temperature Gauges-2 Nos., Flow Switches-1 No., etc.	Set	2
E.10.2	Lub Oil Skids for FD Fans: The scope of work includes removal of instruments for calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantity of instruments for the skid: Level Indicator-1No, Temperature Gauge-4Nos., Level Transmitter(DP Type)-2 Nos., Differential Pressure Gauge-3 nos., Pressure Gauge-2 Nos., ifferential Pressure Transmitter-1 Nos., Pressure Tansmitters-2 Nos., etc.	Set	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
E.10.3	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 total quantity of instruments for the skid: Level Indicator-1No, Temperature Gauge-4Nos., Level Transmitter(DP Type)-2 Nos., Differential Pressure Gauge-3 nos., Pressure Gauge-2 Nos., Differential Pressure Transmitter-1 Nos., Pressure Transmitters-2 Nos., etc.	Set	2
E.10.4	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 total quantity of instruments for the skid: Level Indicator-1No, Temperature Gauge-4Nos., Level Transmitter(DP Type)-2 Nos., Differential Pressure Gauge-3 nos., Pressure Gauge-2 Nos., Differential Pressure Transmitter-1 Nos., Pressure Transmitters-2 Nos., etc.	Set	2
E.10.5	Fan Motor Bearing Temperature Indicators for all fans (Removal, Calibration and refixing only)	Nos	24
E.10.6	Fan Motor Bearing/Winding RTDs (Checking of healthiness only)	Nos	84
E.10.7	Hydraulic Coupling of ID fan: The scope of work covers a) Removal, calibration & refixing of following instruments approximately: Pressure Indicator-1 No., Pressure Transmitters-2 Nos., DP transmitter: 1 No., Temp. indicator-1 No., Temp. transmitters: 6 Nos., RTDs (Checking only): 5 Nos. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. c) Commissioning of Speed Indicator cum transmitter etc.	Set	2
E.11	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)		
E.11.1	Electric Actuators for MOVs, Dampers (Open/ Close, Regulating, Inch)	Nos	19
E.12	Opacity Monitor and accessories	Set	2
E.13	Ball Mill System		
E.13.1	Commissioning of the following erected by mechanical contractor		
E.13.1.1	Motorised Actuators for gates	Nos	4
E.13.1.2	Pneumatic actuators for Gate	Nos	2
E.13.2	Local Instrument Rack	SET	2
E.13.3	Calibration, Erection, Testing and Commissioning of Field Instruments		
E.13.3.1	Temperature Transmitters	Nos	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
E.13.3.2	Flow Transmitters	Nos	2
E.13.3.3	Pressure Transmitter	Nos	2
E.13.3.4	Level Transmitters	Nos	2
E.13.3.5	Local Push Button Station	Nos	4
E.13.3.6	Emergency Push Button Station	Nos	2
E.13.3.7	Junction Box	Nos	2
E.13.3.8	RTD	Nos	2
E.13.3.9	Density Meter	Nos	2
E.13.3.10	Pressure Gauge	Nos	2
E.13.3.11	Pressure Transmitter	Nos	2
F	BHEL SBD SCOPE OF SUPPLY		
F.1	LT Non-Segregated Bus Duct (NSPBD)		
F.1.1	NSPBD TYPE BUSDUCT 3200A, 415 V, for FGD PCC, Approx. weight 250kg/m (X-section 1200mmx1000mm)	Mtrs	24
F.1.2	NSPBD TYPE BUSDUCT 2500A, 415 V, for AMMONIA PCC, Approx. weight (in kg): 250 kg/m,(X-section 1200mmx1000mm)	Mtrs	10
F.2	LT Switchgear		
F.2.1	415V FGD PCC, Approximate Overall Weight (in kg) 10675, Approximate Dimension in mm (LxDxH): 10460X1754X2495 mm, No. of Panels: 14 & No. of Shipping Sections: 6	Set	1
F.2.2	415V AMMONIA PCC, Approximate Overall Weight (in kg) 13365, Approximate Dimension in mm (LxDxH): 12720X1754X2495 mm, No. of Panels: 16 & No. of Shipping Sections: 8	Set	1
F.2.3	415V BOILER MCC, Approximate Overall Weight (in kg) 19920, Approximate Dimension in mm (LxDxH): 28380x1254x2495 mm, No. of Panels: 36 & No. of Shipping Sections: 13	Set	1
F.2.4	415V STG MCC, Approximate Overall Weight (in kg) 6170, Approximate Dimension in mm (LxDxH): 8380X1254X2495 mm, No. of Panels: 11 & No. of Shipping Sections: 5	Set	1
F.2.5	415V MOV DB, Approximate Overall Weight (in kg) 19870, Approximate Dimension in mm (LxDxH): 28860X644X2495, No. of Panels: 36 & No. of Shipping Sections: 13	Set	1
F.2.6	415V BOP MCC, Approximate Overall Weight (in kg) 7820, Approximate Dimension in mm (LxDxH): 10780X1254X2495 mm, No. of Panels: 14 & No. of Shipping Sections: 6	Set	1

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SL NO.	ITEM DESCRIPTION	UOM	QTY
F.2.7	415V EMERGENCY MCC-STG, Approximate Overall Weight (in kg) 16070, Approximate Dimension in mm (LxDxH): 22780X1254X2495 mm, No. of Panels: 29 & No. of Shipping Sections: 11	Set	1
F.2.8	415V AC VENT MCC STG, Approximate Overall Weight (in kg) 7270, Approximate Dimension in mm (LxDxH): 9980X1254X2495 mm, No. of Panels: 13 & No. of Shipping Sections: 6	Set	1
F.2.9	415V AC VENT MCC ESP, Approximate Overall Weight (in kg) 7270, Approximate Dimension in mm (LxDxH): 9980X1254X2495 mm, No. of Panels: 13 & No. of Shipping Sections: 6	Set	1
F.2.10	415V FLAMEPROOF DB, FUEL OIL AREA, Approximate Overall Weight (in kg) 1500, Approximate Dimension in mm (LxDxH): 4705X900X2150 mm, No. of Panels: 4 & No. of Shipping Sections: 2	Set	1
F.2.11	415V FGD MCC, Approximate Overall Weight (in kg) 8370, Approximate Dimension in mm (LxDxH): 11580X1254X2495 mm, No. of Panels: 15 & No. of Shipping Sections: 6	Set	1
F.2.12	415V EMERGENCY MCC-FGD, Approximate Overall Weight (in kg) 13270, Approximate Dimension in mm (LxDxH): 19260X644X2495 mm, No. of Panels: 24 & No. of Shipping Sections: 9	Set	1
F.2.13	415V GYPSUM MCC, Approximate Overall Weight (in kg) 11420, Approximate Dimension in mm (LxDxH): 15180X1254X2495 mm, No. of Panels: 20 & No. of Shipping Sections: 8	Set	1
F.2.14	415V LHP MCC-1, Approximate Overall Weight (in kg) 10570, Approximate Dimension in mm (LxDxH): 14780X1254X2495 mm, No. of Panels: 19 & No. of Shipping Sections: 8	Set	1
F.2.15	415V LHP MCC-2, Approximate Overall Weight (in kg) 14770, Approximate Dimension in mm (LxDxH): 21180X1254X2495 mm, No. of Panels: 27 & No. of Shipping Sections: 10	Set	1
F.2.16	415V PDB-STG, Approximate Overall Weight (in kg) 7220, Approximate Dimension in mm (LxDxH): 10460X644X2495 mm, No. of Panels: 13 & No. of Shipping Sections: 5	Set	1
F.2.17	415V PDB-FGD, Approximate Overall Weight (in kg) 10520, Approximate Dimension in mm (LxDxH): 15260X644X2495 mm, No. of Panels: 19 & No. of Shipping Sections: 7	Set	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL NO.	ITEM DESCRIPTION	UOM	QTY
F.2.18	415V PDB-AMMONIA, Approximate Overall Weight (in kg) 6670, Approximate Dimension in mm (LxDxH): 9660X644X2495 mm, No. of Panels: 12 & No. of Shipping Sections: 5	Set	1
F.2.19	110V DCDB-1, Approximate Overall Weight (in kg) 9720, Approximate Dimension in mm (LxDxH): 13660X944X2495 mm, No. of Panels: 17 & No. of Shipping Sections: 6	Set	1
F.2.20	110V DCDB-2, Approximate Overall Weight (in kg) 3920, Approximate Dimension in mm (LxDxH): 5660X644X2495 mm, No. of Panels: 7 & No. of Shipping Sections: 3	Set	1
F.2.21	110V DCDB-3, Approximate Overall Weight (in kg) 2270, Approximate Dimension in mm (LxDxH): 3260X644X2495 mm, No. of Panels: 4 & No. of Shipping Sections: 2	Set	1
F.2.22	415V WALL MOUNTED DB, Approximate Overall Weight (in kg) 200, Approximate Dimension in mm (LxDxH): 900X400X1000 mm	Set	4
F.2.23	415V ESP ACP/MCC, Approximate Overall Weight (in kg) 13270, Approximate Dimension in mm (LxDxH): 19260X644X2495 mm, No. of Panels: 24 & No. of Shipping Sections: 9	Set	1
F.2.24	415V MOV DB-(FGD & GYPSUM), Approximate Overall Weight (in kg) 16070, Approximate Dimension in mm (LxDxH): 22780X1254X2495 mm, No. of Panels: 29 & No. of Shipping Sections: 11	Set	1
F.2.25	240V WALL MOUNTED ACDB, Approximate Overall Weight (in kg) 200, Approximate Dimension in mm (LxDxH): 900X400X1000 mm, No. of Panels: 1 & No. of Shipping Sections: 1	Set	2
F.2.26	415V SOOT BLOWER MCC, Approximate Overall Weight (in kg) 9420, Approximate Dimension in mm (LxDxH): 13660X644X2495 mm, No. of Panels: 17 & No. of Shipping Sections: 6	Set	1
F.3	Miscellaneous Items		
F.3.1	Local Push Button Station (LPBS)	Nos.	310
F.3.2	Local Motor Isolator (< 125A)	Nos.	610
F.3.3	Local Motor Isolator (125A and above)	Nos.	36
F.4	Lighting Distribution Boards (LDBs)		
F.4.1	415V MLDB- FGD, Approximate Overall Weight (in kg) 3370, Approximate Dimension in mm (LxDxH): 4860X644X2495 mm, No. of Panels: 6 & No. of Shipping Sections: 3	Set	1
F.4.2	415V MLDB- AMMONIA, Approximate Overall Weight (in kg) 4200, Approximate Dimension in mm (LxDxH):	Set	1

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SL NO.	ITEM DESCRIPTION	UOM	QTY
	4860X644X2495 mm, No. of Panels: 6 & No. of Shipping Sections: 3		
F.4.3	415V WDB-AMMONIA (415V MOV DB-FGD & GYPSUM), Approximate Overall Weight (in kg) 7340, Approximate Dimension in mm (LxDxH): 7820X1444X2495 mm, No. of Panels: 9 & No. of Shipping Sections: 5	Set	1
F.4.4	415V UPS ELDB-1,2,3, Approximate Overall Weight (in kg) 2270, Approximate Dimension in mm (LxDxH): 3260X644X2495 mm, No. of Panels: 4 & No. of Shipping Sections: 2	Set	1
F.4.5	110V WALL MOUNT DC ELDB-1,2,3, Approximate Overall Weight (in kg) 200, Approximate Dimension in mm (LxDxH): 900X400X1000 mm	Set	7
G	BHEL TRICHY SCOPE OF SUPPLY		
G.1	Commissioning of the following erected by Mechanical contractor		
G.1.1	LT motors	Nos	11
G.2	Erection and Commissioning of Control Panels		
G.2.1	Gravimetric feeder panel- Size: 1200 mm(L) X 600 mm(D) x 2315 mm(H); Approx. weight 400 kg	Set	4
G.2.2	Flame Scanner Head Assembly consisting fibre optic cable, L72" lense barrel, flame processor module, Flame module, pigtail cable, pico fuse, card extender module, power supply module, 6 way JB, etc	Set	12
G.2.3	Furnace temp. panel size 650 mm(w) x 1000 mm(h)x 300 mm (d) approx, weight 25 kg approx	SET	2
G.3	Laying and Termination of Control/ Instrumentation Cables		
G.3.1	FLAME SCANNER CABLE-P/O SHIELDED	Mtrs	3600
G.3.2	4P X 1.0 SQMM P/O SHIELDED INST. CABLE	Mtrs	3350
G.3.3	8P X 1.0 SQMM P/O SHIELDED INST. CABLE	Mtrs	2200
G.3.4	1P X 1.5 SQMM O/A SHIELDED INST. CABLE	Mtrs	1750
G.3.5	4P X 1.5 SQMM O/A SHIELDED INST. CABLE	Mtrs	2950
G.3.6	8P X 1.5 SQMM O/A SHIELDED INST. CABLE	Mtrs	2450
G.3.7	2T X 1.0 SQMM TRIAD SHIELDED INST. CABLE	Mtrs	550
G.3.8	1P X 1.0 SQMM O/A SHIELDED INST. CABLE	Mtrs	2000
G.3.9	2C X 1.5MM ² ARMOURED CONTROL CABLE	Mtrs	1550
G.3.10	5C X 1.5MM ² ARMOURED CONTROL CABLE	Mtrs	1250
G.3.11	9C X 1.5MM ² ARMOURED CONTROL CABLE	Mtrs	1500
G.4	Cable Tray		
G.4.1	PERFORATED CABLE TRAY - 50 MM WIDTH	Mtrs	400
G.4.2	PERFORATED CABLE TRAY - 100 MM WIDTH	Mtrs	1000
G.4.3	PERFORATED CABLE TRAY - 150 MM WIDTH	Mtrs	375
G.5	Junction Box		

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SL NO.	ITEM DESCRIPTION	UOM	QTY
G.5.1	24 WAY SHEET STEEL JUNCTION BOX	Nos	23
G.5.2	48 WAY SHEET STEEL JUNCTION BOX	Nos	8
G.5.3	24 WAY SHEET STEEL JUNCTION BOX	Nos	9
G.5.4	SHEET STEEL JB WITH DIN RAIL MOUNTED 6TT	Nos	2
G.5.5	SHEET STEEL JB WITH DIN RAIL MOUNTED 4TT	Nos	7
G.6	Push Button Station		
G.6.1	E-STOP PUSH BUTTON STATION	Nos	8
G.6.2	FOGGING PUSH BUTTON STATION	Nos	4
G.7	Calibration, Erection, Testing and Commissioning of Field Instruments		
G.7.1	Pressure gauge	Nos	11
G.7.2	Temperture gauge	Nos	2
G.7.3	Level gauge- Magnetic float type	Nos	2
G.7.4	TUBULAR TANK LEVEL GAUGE - 1700 MM	Nos	1
G.7.5	Pressure Transmitter	Nos	28
G.7.6	DP Transmitter	Nos	7
G.7.7	Flow transmitter (DP type)	Nos	1
G.7.8	PITOT+FLOW TRANSMITTER	Nos	6
G.7.9	DP Level transmitter	Nos	2
G.7.10	Level transmitter- Ultrasonic type	Nos	1
G.7.11	Temperature Element	Nos	17
G.7.12	Temperature transmitter- DIN rail type	Nos	17
G.7.13	Density meter with transmitter	Nos	1
G.7.14	Mass flow meter- NH3 injection skid	Set	1
G.7.15	Level Gauge	Nos	1
G.8	Structural Steel		
G.8.1	2" GI Pipe	Mtrs	180
G.8.2	Structural Steel (Angles ,Channel, etc.)	MT	1
G.9	Earthing Material		
G.9.1	FLAT 50 X 6 - IS2062GRA	Mtrs	55
G.9.2	WIRE DIA 1.219 MM - GI - IS280	Mtrs	190
G.10	Hardware/ Tubing/ Piping		
G.10.1	TUBE OD 6.34 X 1.24- SA213TP316	Mtrs	550
G.10.2	¾" SCH 80 CS pipe	Mtrs	350
G.10.3	½" SCH 80 CS pipe	Mtrs	20
G.11	Commissioning of the following erected by Mechanical contractor		
G.11.1	MOVs	Nos	5
G.11.2	Pneumatic valves	Set	27
G.11.3	Electric Actuator for Dampers	Nos	4
G.12	ECONOMISER BYPASS DAMP. ACT. (14" X 16") and linkage rod	Set	1
H	BHEL PIPING CENTRE		

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SL NO.	ITEM DESCRIPTION	UOM	QTY
H.1	Calibration, Erection, Testing and Commissioning of Field Instruments		
H.1.1	Pressure Gauges	Nos	51
H.1.2	Temp Gauges	Nos	61
H.1.3	Level Gauge	Nos	2
H.2	E&C of Impulse Pipes, Fittings, Manifolds and Accessories		
H.2.1	Seamless Pipe 1/2", Sch. 80 SA106 Gr.B	Mtrs	255
H.3	E&C of GI Pipes, Fittings and Accessories		
H.3.1	PIPENB 15X 3.2 SCREW&SOCKETED (1/2 inch)	Mtrs	1920
H.3.2	PIPENB 25X4.0 SCREW&SOCKETED (1 inch)	Mtrs	710
H.3.3	PIPENB 50X4.50SCREW&SOCKETED (2 inch)	Mtrs	200
H.4	Commissioning of the following erected by Mechanical contractor		
H.4.1	Control valve	Set	2
J	BHEL-HPVP		
J.1	Commissioning of the following erected by mechanical contractor		
J.1.1	LT drives	Nos	176
J.1.2	6.6KV HT motors	Nos	8
J.2	Control Panels		
J.2.1	Fire Protection Panel- Dimn. 670mmx250mmx1275mm with in-built MIMIC Panel, contacts & other Accessories. Overall weight of 1 Panel – approx. 250KG	Set	2
J.2.2	Furnace temperature probe local starter box and remote position indicator. Approx. Overall weight of 1 No. – approx. 800KG	Set	1
J.2.3	FSSS Local gun maintenance switch box- Dimn. 108mm x 80mm x 130mm, Weight- approx. 8 kg	Nos.	8
J.2.4	ERV Controller with Pressure Switch App.Dimension(mm): 400x350x190; App.Wt: 10 kg	Set	1
J.2.5	Microprocessor based flame scanner amplifier 19" rack of size 482x263x134 (WxDxH) to be mounted in flame scanner panel	Set	3
J.2.6	H.E.A Exciter box 240 V AC alongwith retractor assembly 240 V AC solenoid, flexible spark rod 100 inch, spark tip, flexible cable assembly 12 ft long, SS hose 6.35mmx1000mm, Air Filter Regulator 1/4 inch etc.	Set	8
J.3	Calibration, Erection, Testing and Commissioning of Field Instruments		
J.3.1	Mass flow meter in HFO,LDO line with mounting flanges, electronics amplifier box, inter- connecting cabling etc	Set	2
J.3.2	MTM thermocouple- 20 metres length	Nos	29

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SL NO.	ITEM DESCRIPTION	UOM	QTY
J.3.3	MTM thermocouple- 15 metres length	Nos	8
J.3.4	EWLI (HYDRASTEP TYPE)	Set	2
J.4	Erection of Flue Gas Analyzers (Commissioning by OEM)		
J.4.1	SOX/NOX/CO (Combined) insitu analyser system consisting of SO2, NO, CO Sensor head (Inbuilt CO2 & H2O) mounted on probe (approx. 1800mm)with DDU, SS316L Heated Insitu probe insertion length 1.8mtr, pressure transmitter, Temperature Transmitters, mounted heat exchanger, pneumatic panel (approx. size 1200 x 800 x 300 mm) consists of pneumatics, HMI, Power Supply Unit, Probe Heater Control Unit, mounting hardware, PU tube 6mm OD-10m, 8" NB MS Site Flange, MS Pipe 8 inch NB, approx. 300mm long, 10MM OD PU Tube-10m cylinder with regulator, Velocity Monitor consisting of Upstream sensor head with 10m cable, Downstream sensor head with 10m cable, insertion tube 1metre long-2Nos., Air Purge Unit, Signal Processing Unit, Remote Control Unit, Power Supply Unit, Digital Display Unit, Mounting Hardware, FO Cable with HDPE Conduit-3200mtrs, RS485 Modbus Cable-100Mtr, 2channel single mode FO Panel-2nos., Office Furniture comprising of Table and Chair, Standard Span Gas Cylinder for calibration, air dryer unit, auto calibration. Probe located at approx. 40mtrs, Local PC and accessories.	Set	1
J.4.2	CO Analyser consisting of cross duct type CO Analyser for measurement of CO in Flue Gas Duct at APH Inlet , with interconnection cables between transmiiter and Receiver Unit 5m and between Receiver Unit and Control Unit- approx. 10m and calibration kit consisting of Span Gas Cylinder-1No, transmitter and Receiver Unit, Recevier Unit and Control Unit, Dual Stage Brass Pressure Regulator-1No., Calibration Flow Meter-1No., 2 Way Solenoid Valve-2nos., Air Filter Regulator with Pressure Gauge-1No., Calibration cell-1no., etc.	Set	1
J.4.3	Oxygen Analyser for APH inlet consisting of Zirconia Oxygen Converter (1 No.), Zirconia Oxygen Detector (1 No.) with Mounting Flange Nuts, Bolts and Gaskets, Calibration Unit comprising of rotameter-1No., Air Filter Regulator with Pressure Gauge-1No., Two Way Solenoid Valve, tubed with 6mm OD PTFE Tube, Interconnection cable between between probe and electronic Unit- 30mtrs, interconnection tube -30 mtrs, calibration gas cylinders(Zero Gas Cylinder-1No, Span Gas Cylinder-	Set	2

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SL NO.	ITEM DESCRIPTION	UOM	QTY
	1no., 230V Power Supply Unit,etc. Overall weight – approx. 200KG		
J.4.4	Wet Gas Dust Analyser (Smoke Density Analyser Air and Gas), comprising of Probe with mounting flange, gasket and studs, Dust analyser panel (approx. dimension LDXH(in mm) 650x300x1554), consisting of Signal Processing Unit, Power Supply Unit, Mechanical components and Blower Assembly (dim (LxWxH)- 650mmx 300mmx 1554mm), Signal Processing Unit, Power Supply Unit, Mech. Components & Blower Assy., canopy for panel, inlet Silicone Hose ID 32mm, approx. 10 meter length, Outlet hose 63mm length approx. 10m length, screened cables, MODBUS Cables,other accesories, etc.	Set	1
J.4.5	Mercury analyser in flue gas duct consist of sample probe with SS Filter and Probe Filter Heater, counter flange-1no. & Probe mounting accessories, gasket, Umbilical Cord made of 6mm OD Nylon Tube with PVC Jacketing-3nos., heated sampling line of size 3/8" OD 0.04" thickness of PTFE material, K type simples Thermocouple (Cr/Al) with thermowell, with head mounted temperature transmitter, with computer and computer table, 2PX0.5 sqmm signal cable approx. 60mtrs,PLC Panel size 1200mm(W) x 600mm(D) x 2100mm(H) consisting of solenoid valves, Ball Valve, Dilution Probe Controller, Air Purification Unit, Sample Gas Pump, Programmable Logic Controller with HMI, Temperature Indicator and Controller, Hg Vapour Generator, carrier gas cylinders-2nos. etc. Wall mounting type static AC power switching unit, mounted on chimney at approx. 41 mtr elevation.	Set	1
J.6	~~Pneumatic Power Cylinders (Regulating Type)~~ ~~Installation and Commissioning~~	-	-
J.7	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)		
J.7.1	Trip Valves, Control Valves along with Positioner, AFR etc. -	Set	45
J.7.2	Pneumatic actuators- Regulating type for MILL Dampers of PCD 6" X 8" Actuators with in-built Smart Positioner & other Accessories. Approx. Overall weight of 1 No. of PCD – approx. 100KG	Set	10
J.7.3	Pneumatic actuators- Regulating type for MILL Dampers of PCD 8" X 16" Actuators with in-built Smart Positioner	Set	2

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SL NO.	ITEM DESCRIPTION	UOM	QTY
	& other Accessories. Approx. Overall weight of 1 No. of PCD – approx. 180KG		
J.7.4	Pneumatic actuators- Regulating type for FD Fan IGVs of PCD 8" X 8" FD Fan Actuators with in-built Smart Positioner & other Accessories. Overall weight of 1 No. of PCD – approx. 120KG	Set	2
J.7.5	Pneumatic actuators- Regulating type for PAFan IGVs of PCD 8" X 16" PA Fan Actuators with in-built Smart Positioner & other Accessories. Overall weight of 1 No. of PCD – approx. 200KG	Set	2
J.7.6	Pneumatic actuators- Regulating type for ID Fan IGVs of PCD 12" X 16" ID Fan Actuators with in-built Smart Positioner & other Accessories. Approximate Overall weight of 1 No. of PCD – approx. 300KG	Set	2
J.7.7	SADC Pneumatic actuators	SET	44
J.8	E&C of Impulse Pipes, Fittings, Manifolds and Accessories		
J.8.1	SS TUBE 1/4"OD X 0.04 9"THK A269 TP316L	Mtrs	1500
J.8.2	SS TUBE 1/2"OD X 0.06 5"THK A269 TP316L	Mtrs	120
J.8.3	GI PIPE OD 34.2X4.05 THK IS1239(CERTIFIED)	Mtrs	60
J.8.4	PIPE IS 1239 60.8 X 4.5	Mtrs	79
J.8.5	AIR FILTER CUM REGUL ATOR 1/2"NPT(F)	Nos	20
J.8.6	AIR FILTER CUM REGUL ATORS 1/4"NPT(F)	Nos	30
J.9	Structural Steel items like (Angles, Channel, Plates,etc.)	MT	1
J.10	Commissioning of the following erected by mechanical contractor		
J.10.1	Solenoid operated valves	Nos	62
K	BHEL EDN SCOPE OF SUPPLY		
K.1	Placement, alignment,erection, electrical interconnection, testing and commissioning of AC & Ventilation System DCS Panels		
K.1.1	Single Cubicle Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg- CJF07, CJJ02	Nos	2
K.1.2	Suite of two Cubicles Size: 1500 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 800 kg- CAF16-17, CJF20-21, CJF55-56, CAF16-17, CJF53,54	Nos	4
K.1.3	Suite of three Cubicles Size: 2250 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1200 kg- CJF61-63, CJF64-66, CBA01-03, CBA04-06, CBA21-23, CBA24-26, CBA41-43, CBB01-03, CBB11-13, CRE01-03, CRE04-06, CRE07-09, CRE10-12, CRE13-15, CRE16-18, CRE19-21, CRE22-24, CRE25-27, CRE28-30	Nos	19
K.1.4	Suite of four Cubicles Size: 3000 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 1600 kg- CCA01-03,CCA51	Nos	1

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SL NO.	ITEM DESCRIPTION	UOM	QTY
K.1.5	Suite of five Cubicles Size: 3750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 2000 kg- CJF01-05	Nos	1
K.1.6	Network Panel NWPA01, NWPA02, NWAP03 Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg	Nos	3
K.1.7	Interposing Relay Panel Size: 750 mm(W) X 750 mm(D) x 2067 mm(H); Approx. weight 400 kg- CTE01, CTE02, , CTE03, CTE04, CTE05, CTE06, CTE07, CTE08, CTE51, CTE52, , CTE53, CTE54, CTE55, CTE56, CTE57, CTE58	Nos	16
K.1.8	DESK Package Unit Control Panel Size: 1400 mm(W) X 1000 mm(D) x 2355 mm(H); Approx. weight 800 kg	Nos	1
K.1.9	DAVR Panel Size: (750+1500 mm)(W) X 1200 mm(D) x 2065 mm(H); Approx. weight 2000 kg	Set	1
K.2	2x90 kVA UPS System		
K.2.1	2 X90 KVA UPS parallel redundant comprising of the following tentatively : UPS-1 , UPS 2, Rectifier Panels, Inverter panels, Input Iso. Transformer & SCVS panels. Over all size 5300 mm (L) x 1000 mm(W) x 2040 mm(H) approx weight 2100 Kg.	Set	1
K.2.2	ACDB :over all size 1800 mm(L) x 400 mm(D) x 1850 mm(H) mm; aprox weight 500 kg	Nos	2
K.2.3	Laying of 2CX120 sqmm cable from UPS to Battery	Mtrs	50
K.2.4	Laying of 2CX70 sqmm cable from UPS to ACDB	Mtrs	50
K.2.5	Modbus (RS485) cable	Mtrs	50
K.2.6	Termination of 2CX120 sqmm cable	Nos	4
K.2.7	Termination of 2CX70 sqmm cable	Nos	8
K.3	UPS BATTERY: 480 AH/ 220 V VRLA Battery. Each battery is made of 180 cells, steel module,base support, along with inter cell, inter tier, inter module and inter stack sleeved connectors, insulation pad, tie plate, SS fasteners, etc. Approx. dimension of 6 Cell Module in mm: 637(L) x 581(W) x 360(H). App. 6 cell module weight is 204 kg with electrolyte.	Set	2
K.4	2x45 kVA UPS System		
K.4.1	2 X45 KVA UPS parallel redundant comprising of the following tentatively : UPS-1 , UPS 2, Rectifier Panels, Inverter panels, Input Iso. Transformer & SCVS panels. Over all size 3000 mm (L) x 1900 mm(W) x 1870 mm(H) approx weight 1050 Kg.	Set	1
K.4.2	ACDB :over all size 1100 mm(L) x 400 mm(D) x 1850 mm(H) mm; aprox weight 400 kg	Nos	2
K.4.3	Laying of 2CX70 sqmm cable from UPS to Battery	Mtrs	50
K.4.4	Laying of 1CX120 sqmm cable from UPS to ACDB	Mtrs	50
K.4.5	Modbus (RS485) cable	Mtrs	50

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SL NO.	ITEM DESCRIPTION	UOM	QTY
K.4.6	Termination of 2CX70 sqmm cable	Nos	4
K.4.7	Laying of 1CX120 sqmm cable	Nos	8
K.4.8	UPS BATTERY: 400 AH/ 220 V VRLA Battery. Each battery is made of 110 cells, steel module, base support, along with inter cell, inter tier, inter module and inter stack sleeved connectors, insulation pad, tie plate, SS fasteners, etc. Approx. dimension of 8 Cell Module in mm: 755(L) x 435(W) x 377(H). App. 8 cell module weight is 214 kg with electrolyte.	Set	2
K.6	E&C OF HMI & PIS System Package		
K.6.1	Operator WorkStation/Engineering Work Station/SOE/Alarm Station/Performance Calculation/Storian Station/MIS/OPC Server, etc. including monitor(s)	Set	12
K.6.2	B/W/ Colour Printer (A3/A4 size)	Nos.	4
K.7	Computer furniture		
K.7.1	Operator Desk of 6 Sections arrangement Approx. overall dimensions in mm: Height X Length X Width = 750mm X 7221mm X 3652mm including fixing of power sockets, MCBs, ethernet switches, other accessories etc. Depth of each section 1050 mm along with chairs	Set	1
K.7.2	Engineer Station Desk H X W X D = 750mm X 1500mm X 1050mm including fixing of power sockets, MCBs, ethernet switches, other accessories etc. along with chairs	Set	1
K.7.3	Computer Table H X W X D = 750mm X 1000mm X 1050mm including fixing of power sockets, MCBs, ethernet switches, other accessories etc. along with chairs	Set	5
K.7.4	Printer Table H x W x D = 740mm X 900mm X 650mm including fixing of power sockets, MCBs, ethernet switches, other accessories etc	Set	4
K.8	Large Video Screen System: Large Screen LED Display Min 80" inch alongwith its Work Station and other loose accessories	Set	1
K.9	4C SM Fibre Optic Cable	Mtrs	5000
K.10	Splicing of Optical Fibre Cable	Nos	30
K.11	Turbine Supervisory System for Main Turbine		

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SL NO.	ITEM DESCRIPTION	UOM	QTY
K.11.1	Collection of materials from stores, Preparation of mounting surface and mounting arrangement to suit the surface of the machine: Relative shaft vibration sensor along with associated cables -12 Nos, Axial Displacement Probes along with associated cables-2 Nos., Eccentricity measurement sensor along with associated cable-1 No., Phase Mark along with associated cables-2 Nos., Transducer along with 4-20mA output & integral cable, Junction Boxes-11nos., 19 inch Instrument Rack, Power Supply Unit, other accessories etc., Flexible conduits-150 Mtr., Cable seal, Cable connectors, Mounting brackets for vibration/differential exp/brg housings, Cabling from Junction Box to Monitors(upto 300mtrs), 50m cat 6 cable from switch to server, server with 24" TFT Monitor, etc.	Set	1
K.12	Local Instrument Enclosures/ Racks		
K.12.1	Local Instrument Enclosure (LIE) Type- A- 1450(W) x 1000(D) x 2200(H); Approximate weight: 900 kg each	Set	1
K.12.2	Local Instrument Enclosure (LIE) Type- B- 1100 (W) x 1000(D) x 2200(H); Approximate weight: 600 kg each	Set	5
K.12.3	Local Instrument Enclosure (LIE) Type- C- 800(W) x 1000(D) x 2200(H); Approximate weight: 400 kg each	Set	10
K.12.4	Local Instrument Rack (LIR) - Type-A- 1400(W) x 650(D) x 2200(H); Approximate weight: 600 kg each	Set	1
K.12.5	Local Instrument Rack (LIR)- Type-B- 1100(W) x 650(D) x 2200(H); Approximate weight: 400 kg each	Set	2
K.12.6	Local Instrument Rack (LIR)- Type-C- 800(W) x 650(D) x 1600(H); Approximate weight: 250 kg each	Set	2
K.13	E&C of Impulse Pipes, Fittings, Manifolds and Accessories		
K.13.1	Impulse Pipe ASTM A106 Gr.C Size:1/2"NB Sch 80	Mtrs	2500
K.13.2	Impulse Pipe ASTM A106 Gr.C Size:3/4"NB Sch 80	Mtrs	1300
K.14	Calibration, Erection, Testing and Commissioning of Field Instruments		
K.14.1	Pressure Switch	Nos	6
K.14.2	Pressure Gauge	Nos	38
K.14.3	Temperature Gauge	Nos	4
K.14.4	Void		
K.14.5	TRANSDUCER 4-20MA; 3-15 PSI for SADC	Nos	9
K.14.6	Pressure Switch for SADC	Nos	9
K.14.7	Air Filter Regulator 0-50 PSI/1/4" NPT(F) for SADC	Nos	9
K.14.8	SADC I/P Converters	Nos	44

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SL NO.	ITEM DESCRIPTION	UOM	QTY
K.15	Erection of Master and Slave Clock System (Commissioning by OEM)		
K.15.1	Fully wired Master clock System Panel (App.Size: 800 x 800 x 2415 mm; wt. 600 kg) - 01 No., alongwith accessories power supply unit, signal conditioners etc. GPS antenna to receiver unit (Unarmoured low loss antenna cable with flexible metal conduit pipe- 200mtrs)	Set	1
K.15.2	Slave clock (Rs 485 based) for various locations	Nos	15
K.15.3	Laying and termination of RG 58 Coaxial Cable FRLS armoured	Mtrs	1500
K.15.4	CAT 5E/ CAT 6 Ethernet Cable	Mtrs	915
K.15.5	Laying and termination of Armoured Signal Cable 2Cx0.5 sqmm	Mtrs	6000
K.15.6	Laying and termination of power cable 3Cx 1 sqmm	Mtrs	3000
K.15.7	Laying of Fibre Optic cable	Mtrs	5000
K.15.8	Splicing of Optical Fibre Cable	Nos	32
K.16	Erection and Commissioning of VIBRATION MONITORING SYSTEMS		
K.16.1	Installation of piezo velocity transducers, driver, extension cable, SS Conduits with mounting pads Approx. Qty-36 nos(2 nos. piezo velocity transducers per mounting block), Junction Box-36 Nos, with four channel monitoring system consisting of 19" instrument rack-3nos., power supply unit-3nos., local communication module with phase markers-3Nos., vibration thrust with four channel monitor with built in relays- 26 nos.2 Bay type Panel-1No., 7 inch. HMI, etc. This broadly covers Main Vibration Monitoring System	Set	1
K.16.2	Installation of piezo velocity transducers, driver, extension cable, SS Conduits with mounting pads Approx. Qty-26 nos(2 nos. piezo velocity transducers per mounting block), Junction Box-26 Nos, with four channel monitoring system consisting of 19" instrument rack-2nos., power supply unit-2nos., local communication module with phase markers-2Nos., vibration thrust with four channel monitor with built in relays- 19 nos.Single Cabinet-1No., 7 inch. HMI, etc. This broadly covers Vibration Monitoring System for FGD System	Set	1

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SL NO.	ITEM DESCRIPTION	UOM	QTY
K.16.3	Installation of piezo velocity transducers, driver, extension cable, SS Conduits with mounting pads Approx. Qty-2 nos(2 nos. piezo velocity transducers per mounting block), Junction Box-2 Nos, with four channel monitoring system consisting of 19" instrument rack-1no., power supply unit-1no., local communication module with phase markers-1No., vibration thrust with four channel monitor with built in relays- 3 nos.Single Cabinet-1No., 7 inch. HMI, etc. This broadly covers Vibration Monitoring System for Switchgear.	Set	1
K.16.4	Loop checking using Portable Shaker Table for each vibration sensor and eddy-current sensors.	Nos	128
K.17	Erection of Analysers (Commissioning in vendor scope)		
K.17.1	pH Analysers	Nos	5
K.17.2	FGD SO2 analyser- system Consisting of in-situ dilution Probe (long 1500 mm) flange mounted, umbilical cord 1x1/4 inch teflon & 3 x 1/4th nylon pvc jacketing 100 mtr long , span/back flush, dilution air, Dilution control unit with auto calibration. solenoids, pressure gauges, flow meter, air dryer with filter arrangement, calibration gas cylinders 10 ltr capacity 4 sets with rack stand, Analyser panel (800mm x 800m x 2300mm) fitted air condition & 19 inch racks, tubing & sampling panel + analysers. The tubing/ signal, control, power cabling between probe and Analyser panel is approx 100 mtrs long, 800 mmx 2100 mm (H). Local PC based DAS consist of 24-inch monitor, processor with key board and accessories.	Set	2
L	REMOVAL, CALIBRATION & RE-FIXING OF INSTRUMENTS FOR ACID CLEANING,ETC.		
L.1	Temp. Gauges	Nos	3
L.2	Pressure Gauges	Nos	4
L.3	Thermocouple Stem type and MTM	Nos	8
L.4	Junction Boxes	Nos	3

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.100/- Stamp Paper for preparation of Contract Agreement.
- 1.10.2 Successful Bidder are 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.
- 1.10.2.1 Wages paid to the workmen by the Bidder should not be less than the rates specified by the Central Govt. as per Minimum Wages Act, 1948 and as adopted by NALCO from time to time.
- 1.10.2.2 Wages to the workmen should be paid on or before the 7th of the subsequent month. If 7th falls on a holiday or weekly off day, the payment should be made one day prior to that.
- 1.10.2.3 Where the Minimum wages notified by the concerned State Government are higher than the rates notified by the Central Government, the states Government rates should apply in concerned scheduled employment as long as the same remains higher than the Central Government rates. The classification on workers in different categories will be as per the notification issued by the Central Govt. fixing the minimum wages for the above scheduled appointment.
- 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:**
 - 1.10.3.1 **PROVIDENT FUND**
 - 1.10.3.1.1 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

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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.

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

1.10.3.2 OTHER STATUTORY REQUIREMENTS

1.10.3.2.1 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.

1.10.3.2.2 The contractor 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.

1.10.3.2.3 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.

1.10.3.2.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen under ID 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.

1.10.3.2.5 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

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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.

- 1.10.3.2.6 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.

1.10.4 Site Visit by the Bidder

- 1.10.4.1 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.

- 1.10.4.2 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 therefrom.
- 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

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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.

1.10.4.3 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.

1.10.4.4 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.

1.10.4.5 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.

1.10.5 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 adequate trained, qualified and experienced supervisory staff and skilled personnel.

1.10.6 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 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.

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

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accordance with drawings, specifications and manufacturer's recommendations.

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

1.10.10 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.

1.10.11 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.

1.10.12 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.

1.10.13 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.

1.10.14 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.

1.10.15 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.

1.10.16 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.

1.10.17 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion

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time for construction, agreed will be subject to the condition that contractor's work is not hampered by the agencies.

- 1.10.18 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.
- 1.10.19 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.
- 1.10.20 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.
- 1.10.21 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.
- 1.10.22 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.
- 1.10.23 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.
- 1.10.24 Contractors shall ensure that all their Staff / Employees are exposed to

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- periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.
- 1.10.25 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.
- 1.10.26 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.
- 1.10.27 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.10.28 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.
- 1.10.29 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.
- 1.10.30 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.
- 1.10.31 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.
- 1.10.32 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 draws at the rate prescribed by manufacturing units.
- 1.10.33 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

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/ on the equipment's coming under this scope.

- 1.10.34 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.

1.10.35 SITE INSPECTION

- 1.10.35.1 The Owner or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the Owner or his authorized agents without any extra cost to the Owner or his authorized agents. No cost whatsoever such duplication of inspection of work be entertained.
- 1.10.35.2 BHEL / Owner 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 Owner / BHEL.
- 1.10.35.3 The contractor shall maintain at site a joint protocol for recording actual measurement of work carried out at site, inspection and witnessing of various tests conducted by the contractor.
- 1.10.35.4 Field Quality Assurance (FQA) Formats: -
It is the responsibility of the contractor to collect and fill up the relevant FQA log sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL and Owner as token of their acceptance. Payment to the contractor will be inked with the submission of these FQA log sheets.
- 1.10.35.5 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.
- 1.10.35.6 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.
- 1.10.35.7 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.
- 1.10.35.8 1Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay

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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.

1.10.36 Comprehensive General Liability Insurance

- 1.10.36.1 This insurance shall protect the Bidder against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Bidder, his agents, his employees, his representative and sub-contractors or from riots, strikes and civil commotion. This insurance shall cover all the liabilities of the Bidder arising out of the relevant clauses of enquiry documents.
- 1.10.36.2 The hazards to be covered will pertain to all the works which and areas where, the Bidder, his Sub-contractors, his agents and his employees have to perform work pursuant to the contract.
- 1.10.36.3 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Bidder to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the contract.

1.10.37 Liability for Accident and damage

The Contractor shall Indemnify the Purchaser against any claims which may be made under the workman's Compensation Act, 1923, or any statutory modification thereof or otherwise for or in respect of any damages under the workman's Compensation Act, 1923, or any statutory modification thereof or otherwise for or in respect of any damages or compensation payable in consequence of any accident or injury sustained by any workman or other person whether in the employment of the Contractor or not.-

- 1.10.38 The bidder should have un-blemished reputation and should not be penalized by NALCO or other Govt. organization in the past. Bidders not satisfying this condition are liable to be rejected.**

1.10.39 OTHER GENERAL REQUIREMENTS

- 1.10.39.1 The scope of specification covers the installation, testing and commissioning of the erected equipment / instrument along with accessories as detailed in Bill of Quantity.
- 1.10.39.2 Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at

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- 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.
- 1.10.39.3 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.
- 1.10.39.4 It is covere 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.
- 1.10.39.5 The contractor shall have valid ELECTRICAL LICENCE as required to carry out the scope of work indicated in the BOQ.
- 1.10.39.6 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.
- 1.10.39.7 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.
- 1.10.39.8 Bidders are requested to visit site to see the site condition, prevailing local laws etc. No claim shall be entertained to lack of knowledge of site condition.
- 1.10.39.9 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, etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff

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- and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works. Proper
- 1.10.39.10 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.
- 1.10.39.11 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.
- 1.10.39.12 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.
- 1.10.39.13 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.
- 1.10.39.14 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.
- 1.10.39.15 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.

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- 1.10.39.16 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.
- 1.10.39.17 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.
- 1.10.39.18 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 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. All the package materials, including special transporting frames, etc., shall be returned to the BHEL stores / customer's stores by the contractor.
- 1.10.39.19 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.
- 1.10.39.20 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.,
- 1.10.39.21 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.
- 1.10.39.22 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.
- 1.10.39.23 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.

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- 1.10.39.24 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.
- 1.10.39.25 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.
- 1.10.39.26 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.
- 1.10.39.27 Gate Pass for Bidder's Labour:
- I. The Bidder shall arrange to obtain from the Owner the required gate pass for entry to the Owner's Works for each one of his workmen and staff as per the Owner's prescribed procedure and format. Each gate pass shall contain the photograph of the person concerned. In the event of loss and/or damage to the gate pass the Bidder shall pay to the Owner the prescribed penalty before a new gate pass can be issued.
 - II. All gate passes, for the entry of labour inside the Works, engaged by or through the Bidder and all material gate passes will be issued only in the name of the Bidder, and he will be directly responsible for the same. All gate passes issued as aforesaid to the Bidder shall be returned by the Bidder to the Owner on completion of the Works or on termination of the Contract.
- 1.10.39.28 The contractor must ensure the necessary formalities like availability of gate pass, etc. for bringing any of their materials inside the site premises. The contractor must obtain the signature and permission of the security personnel of the customer 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.
- 1.10.39.29 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.

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- 1.10.39.30 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.
- 1.10.39.31 No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.10.39.32 Contractors shall ensure that all their Staff/Employees are exposed to periodical training program conducted by qualified agencies/ personnel on ISO 9001/2015 Standards.
- 1.10.39.33 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.
- 1.10.39.34 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.
- 1.10.39.35 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.
- 1.10.39.36 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.
- 1.10.39.37 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.
- 1.10.39.38 All the equipment /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.
- 1.10.39.39 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

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BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.

- 1.10.39.40 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.
- 1.10.39.41 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.
- 1.10.39.42 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.
- 1.10.39.43 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.
- 1.10.39.44 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. Also refer the clause - ELECTRICAL INSPECTORATE'S APPROVAL below.

1.10.40 ELECTRICAL INSPECTORATE'S APPROVAL

- 1.10.40.1 Contractor is responsible for getting Electrical Inspector/statutory authority's approval for all electrical installation covered in their scope. This also includes the Electrical equipment that are erected by mechanical contractor for which commissioning assistance is to be provided by the Electrical contractor.
- 1.10.40.2 All electrical installation covered in contractor's scope which also includes equipment covered in commissioning assistance are to be inspected/approved by the electrical inspector/statutory authority. For getting electrical inspector approval, contractor shall arrange the following:
 - a. Work Completion certificate for all the equipment covered in the contract
 - b. Details of Equipment (specification).
 - c. Test results conducted at site for all the equipment including electrical equipment erected by Mechanical contractor.

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- 1.10.40.3 Any other documents as required by statutory authority. Any expenditure related to documentation shall be borne by contractor.
- 1.10.40.4 Contractor shall carry out the modifications/rectifications, if any, as suggested by the authority at their cost. However, it is not applicable for equipment erected by Mechanical contractor.
- 1.10.40.5 Contractor shall also have valid electrical installation license on their company as well as for individuals acceptable to respective state electrical inspectorate requirement.
- 1.10.40.6 The contractor shall arrange necessary statutory inspections and obtain certificate for installation work at their cost. Any Expenditure related to documentation shall be borne by the contractor. Contractor shall pay all fees relates to electrical inspectorate approval. However, BHEL shall reimburse all statutory fees on production of receipts (FEES FOR VISITS, INSPECTION FEES, REGISTRATION FEES and any other statutory fees).
- 1.10.40.7 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 design change shall be treated as extra work.

1.10.41 MANPOWER REQUIREMENT

- 1.10.41.1 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.

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- 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) Licensed supervisor-01 No. with valid HT electrical license
 - i) HT cable jointer-01 No. should be available on 24x7 basis
 - j) Dedicated commissioning engineer should be deployed for commissioning of the equipment.
 - k) Licensed supervisor-01 No. with valid HT/LT electrical license
- 1.10.41.2 There shall be three separate Erection In-charges, each for HT electrical work, LT electrical work and C&I work. They shall work independently with required manpower, T&P etc., including storage facilities. 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.
- 1.10.41.3 There shall be separate engineers for Planning, Safety and Quality.
- 1.10.41.4 Planning/Safety Engineers should have experience in construction field especially in power plant.
- 1.10.41.5 Each Erection In-charge shall have suitable number of erection engineers who shall be in charge of TRANSFORMERS, BUS DUCT, SWITCHGEAR & CONTROL PANELS AND CABLES & TRAYS.
- 1.10.41.6 Each area engineer shall be provided with adequate number of Supervisors and 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.
- 1.10.41.7 The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor.
- 1.10.41.8 The testing Engineers/supervisors/electricians shall be identified separately for each unit as per the site requirement.
- 1.10.41.9 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.

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- 1.10.41.10 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.
- 1.10.41.11 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.
- 1.10.41.12 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.
- 1.10.41.13 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.
- 1.10.41.14 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.
- 1.10.41.15 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.
- 1.10.42 DOCUMENTATION**
- 1.10.42.1 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.
- 1.10.42.2 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

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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.

1.10.43 **Social Accountability 8000 (SA 8000)**

The Bidders may be aware that NALCO are installing and implementing Social Accountability 8000 (SA 8000). As a part of Implementation, it is necessary that all bidders, sub-contractors of NALCO make a written commitment to conform all requirements of SA 8000. Bidder to submit / upload with his Part-I bid details of SA 8000 as per Appendix – 1 in Part II of specification.

- 1.10.44 The bidder to follow NALCO's occupational health & safety policy. The bidder has to ensure attendance in a training programme for all his contract workers conducted by safety department and obtain a certificate before putting the workers to work front. The bidder has to adhere to "NALCO's safety code for contractors" while executing the work and the same has to be collected from NALCO's T & C department.

Medical Check-up: The bidder will have to submit medical certificate from a Govt. Hospital or registered medical practitioner in the prescribed format for the workmen engaged by him along with application for gate pass and for annual renewal. No gate pass will be issued / renewed unless the medical certificate is enclosed along with the application.

- 1.10.45 No female labour shall be employed during dark hours.

- 1.10.46 The Engineer in-charge executing the contract upon his satisfaction that the bidder is not performing as per the safety requirements may direct stoppage of work. The bidder shall not proceed with the work until he has complied with such directions to the satisfaction of concerned Engineer in-charge.

Without prejudice to the right conferred by the 1.10.14 above for stoppage of work for violating of safety requirements, the bidder shall be liable for penalty up to Rs. 3,000/- for the first violation and up to Rs. 5,000/- for the second violation. For the third violation, he shall be liable to be debarred from further contracts up to a period of one-year minimum from the date of

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completion of jobs in hand.

1.10.47 NON-COMPLIANCE OF THE SHE AND SAFETY NORMS

Penalty may be imposed on successful bidder and their sub-contractors/subvendors working in the Project for non-compliance to the SHE (Safety, Health & Environment) requirements working in the Project as per The National Aluminium Company Limited (NALCO)'s norms.

1.10.48 ENVIRONMENTAL CLAUSE (ISO-14000)

In line with the requirement of ISO – 14001, all Bidders shall comply with the following:

- i) Each and every Bidder engaged inside the Works shall maintain the upto-date training certificate of their employees of Environment. The training shall be provided during safety & Environment training prior to start of the job.
- ii) Any earth excavated during the job shall be disposed off in a preassigned area. The Bidder shall take preventive steps to avoid spillage of earth/debris during transport/dumping.
- iii) Maintain a clear work area in and around the work place.
- iv) Ensure optimum use of water and avoid misuse/ wastage.
- v) Ensure that the vehicles used by them meet the emission norms. These are being checked by Owner's Safety department.

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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. **For Poles:** PCC Foundations for poles is in the scope of the contractor. All materials required for the above shall be part of contractor's scope within the quoted rate. No extra payment will be made for materials to be arranged by contractor.
- 1.11.1.3. **For Road Crossing:** Cables wherever required shall pass through the hume pipes. Laying of hume pipes is excluded from the scope of the bidder. However, laying of cables through hume pipes of required length and closing the ends of hume pipes by suitable cover is in the scope of bidder. Any incidental materials required then and there shall be part of contractor's scope within the quoted rate. No extra payment will be made for materials to be arranged by contractor.
- 1.11.1.4. **For Underground Cabling:** Contractor has to make arrangement for cables which are to be laid underground as per drawing. Civil Works related to laying of Underground Cables are excluded from the scope of bidder. All materials required for Underground Cabling except cables shall be part of contractor's scope within the quoted rate. No extra payment will be made for materials to be arranged by contractor.
- 1.11.1.5. 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.
- 1.11.1.6. 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

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prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.

- 1.11.1.7. 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.
- 1.11.1.8. 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.
- 1.11.1.9. 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.
- 1.11.1.10. 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.
- 1.11.1.11. 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.
- 1.11.1.12. 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.
- 1.11.1.13. Shims and packer plates required for temporary use are to be arranged by the contractor within the quoted rate.
- 1.11.1.14. 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.
- 1.11.1.15. 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.

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- 1.11.1.16. 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.
- 1.11.2. **PROCEDURE FOR GROUTING:** Contractor has to carry out the grouting as per the work instructions for grouting available at site.

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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 damp, sinking into around and to circulate air

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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. 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.
- 1.12.2.14. 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

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required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

- 1.12.2.15. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site.
- 1.12.2.16. 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.
- 1.12.2.17. 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.
- 1.12.2.18. 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.
- 1.12.2.19. 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.

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VOLUME-IA PART – I CHAPTER- XIII **SCOPE OF 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. TRANSFORMERS AND NGRs

1.13.1.1. Refer BoQ for details of different types of transformers like oil immersed or dry type and NGRs.

The scope of erection includes minor civil works such as chipping/grouting of support structure, final painting etc.

1.13.1.2. NOTE:

- a. Responsibility of contractors to obtain customer protocols with respect to Field Quality Plan.
- b. SFRA (Sweep Frequency Response Analysis) test shall be conducted for GT & ST.
- c. Before charging the oil filled transformers, Particle Count Test shall be carried out as per latest standards wherever required by BHEL site engineer.
- d. Necessary equipment's T&P to conduct the test shall be arranged by the contractor within the quoted rates.
- e. DGA Analysis for power transformers oil
- f. Frequency of DGA test to be carried out as under.
- g. Before commissioning as benchmark value and to ensure that the oil has been properly degassed.
- h. Within 24 hrs of charging/operation.
- i. Within one week of 1st charging or operation
- j. Within 1 month of 1st charging or operation.
- k. Every 3 months Log book to be maintained all records of DGA test report.
- l. Record of online DGA trends to be recorded.
- m. Precautionary measure to be taken before taking oil sample.
- n. Since gases content are measured in very low magnitude i.e. in terms of parts per million and also its concentration is effected by various parameters like different solubility coefficients of different gases, exposure to atmosphere, air, heat, sunlight etc., therefore it is very important to exercise extreme caution during sampling as well as its storage prior to testing.

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- o. Oil can be sampled through sampling valve near bottom and top of tank. Special care has to be taken not to introduce air, dirt, foreign matter or dirty oil into the sampling container. For this purpose, first 1-2 liters of oil from transformer shall be flushed out through the oil container under a turbulent flow so that all contaminants are removed from the oil path and sampling container shall also be rinsed with oil. Only Stainless steel or glass bottle shall be used for sampling. It is to be ensured that sample is not exposed to light and it should be perfectly tight to prevent any air ingress. If glass container is used it should be dark in color. Shape of the container and sampling method shall be as guided by the BHEL site engineer . Also refer IEC-60475. Alternate sampling procedures as per IEC-60475 is also acceptable.

1.13.2. **SCOPE OF WORK OF TRANSFORMER**

- 1.13.2.1. Receipt of transformer and associated loose supplied accessories & Spares including oil in drums from site store/yard, inspection, preservation with N₂, transporting the above to respective erection location up to plinth, storage, maintenance of N₂ gas pressure in transformer tank, erection of transformer and all the accessories including NGR, cabling from transformer accessories to marshalling KIOSK & OLTC panel, oil filling, oil pressure testing, dry out, pre-commissioning test, commissioning of equipment and final painting and handing over.

Note: Refer Volume-1A, Part-II, and Chapter-3 for General Technical Requirements for erection, testing and commissioning

- 1.13.2.2. Contractor shall arrange supply of Preservative gas like N₂ to maintain the N₂ pressure during preservation. (only for preservation purpose).
- 1.13.2.3. Before loading and transporting the Transformers, contractor shall study the soil condition and identify the route for transportation.
- 1.13.2.4. Generator Transformer(GT), Station transformer (ST) & Unit Transformer (UT) shall be usually unloaded nearer to the Erection location. The scope of work includes shifting the transformer from this location on to the Transformer foundation and carrying out assembly and testing.
- 1.13.2.5. All the other transformers except GT,ST & UT shall be transported from BHEL storage yard in a suitable trailer, unloaded at their respective locations and install as per the installation drawing. The contractor will unload the transformers on rails turn the wheels / rollers if necessary for changing over at right angles on rails, roll the transformers to their respective locations and put them on the foundation. The necessary sleepers, winches, jacks etc., required for this operation will be arranged by the contractor at their cost. The other transformers will be shifted with suitable material handling equipment to the respective location.

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- 1.13.2.6. GT, ST, UT, SAT, UAT and other transformers shall be dispatched to site in several packages which shall be assembled /erected at site. Contractor shall carry out assembly at site and carry out testing as per requirement.
- 1.13.2.7. Samples of each and every drum of Transformer oil have to be tested and pre-treated to achieve the desired value before filling in to the transformer tank. The entire arrangement for testing the oil sample, filtering whenever required to achieve the desired PPM, BDV within the shortest time shall be made by the contractor. Oil tests as per IS 335 including dissolved gases analysis has to be conducted by contractor for transformers of rating above 200 KV. The job has to be taken up in consultation with BHEL Engineers at site at the cost of the contractor. All the test equipment for testing PPM, BDV of the oil including testing equipment required for the Tan-Delta Test of the transformer winding and HV Bushing shall be arranged by the contractor. HV Bushings shall be tested for capacitance and tan delta test before erection also. Testing instruments required for DEW measurement of N₂ gas shall also be arranged by the contractor.
- 1.13.2.8. The contractor shall arrange suitable filtering machines of capacity 10-12 KL or 5-6 KL / hr capacity or any other suitable capacity as required (Refer Vol 1A, Part 1 Chapter IV) to meet the erection / commissioning schedule. Oil filtration shall be carried out periodically to maintain the BDV value of the transformer until handing over the electrical package.
- 1.13.2.9. All the T & P, material handling equipment like cranes, Trailer, 1 (one) number of High Vacuum filter machines with adequate capacity 10-12KL/ 5 to 6 KL/hr or any other suitable capacity, vacuum pumps and 5 kV motorized megger and oil tanks of suitable capacity shall be arranged by the contractor at their cost. The transformers may have to be suitably lagged / covered during the drying out operation by the contractor at no extra cost.
- 1.13.2.10. During oil circulation of the transformer, the contractor shall employ sufficient number of personnel on three-shift operation to take care of the operation of the filter machine as well as safety of the transformer.
- 1.13.2.11. Unit and Auxiliary Service transformers shall be bolted to the adopter panel/bus duct on the LT sides and the bus bars shall be connected together. The contractor shall carry out any modification required to match the bus bar or bus duct connection.
- 1.13.2.12. The contractor shall carry out testing and commissioning works with their own testing equipment and testing teams. Testing shall be done under the supervision of BHEL/customer Engineers.
- 1.13.2.13. All testing equipment (IMTE) shall be calibrated before putting into service at site. A copy of calibration certificate to this effect shall be furnished to BHEL-Engineer for their verification and approval.

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- 1.13.2.14. All the transformers protective system such as Buchholz relay explosion vent, oil and winding temperature detectors etc., healthiness is to be checked under the guidance of BHEL engineer. All HV bushings will have to be tested for capacitance and tan delta value. All transformers of 220 KV and above shall be tested for capacitance and tan delta value after commissioning.
- 1.13.2.15. Transformer protective relays are to be checked prior to the commissioning of the transformer.
- 1.13.2.16. The scope of work shall also include minor civil work such as chipping and grouting of the support structure as well as for the support of the transformer.
- 1.13.2.17. Final painting shall be carried out for all Transformers. The scope of final painting shall include supply of paints, thinner and other consumables as detailed in the painting clause. No separate rate shall be paid for painting.
- 1.13.2.18. The contractor shall maintain the equipment erected and commissioned by them until taken over by Customer or till the completion of the contract period.
- 1.13.2.19. The contractor shall prepare all erection/ commissioning log sheets, protocols/test certificates as per field quality plan, get it signed by the concerned BHEL / Customer Engineer and submit the same to BHEL Engineer as per their instruction.
- 1.13.2.20. The contractor has to ascertain the quantum of work involved and quote lump sum rate for erection, testing and commissioning of each transformer.
- 1.13.2.21. Filtration and dry out shall be carried out to obtain value of dielectric strength / PPM, resistivity, specific gravity, dissolved gas analysis, and Tan-Delta test shall be as per recommended value of BHEL. The final tests have to be carried out at approved laboratories like CPRI (before charging of transformer & after charging of transformer) etc. and test certificates are to be submitted to BHEL. If the test results are not satisfactory and if the customer desires to carry out the tests through some other agency, the same shall be carried out at contractor's cost.
- 1.13.2.22. Contractor shall arrange to paint/stick good quality danger boards where ever required. Required boards shall be arranged by contractor. Name of the equipment erected by the contractor shall be painted boldly as per the agreed colour scheme on the equipment. value of the transformer until handing over the electrical package.
- 1.13.2.23. The installation of transformers shall also generally conform to the 'Manual of Transformers' by the Central Board of Irrigation and Power (CBIP).
- 1.13.3. **HT SWITCHGEARS -11kV /3.3 kV & GENERATOR / TRANSFORMER CONTROL / RELAY PANELS AND OTHER CONTROL PANELS INCLUDING DAVR ETC:**
 - 1.13.3.1. HT Switchgear shall be generally installed in PH building/ ESP Building. The HT switchgears panel consists of a fixed portion (and a moving portion) of modular construction having three high voltage chambers namely breaker chamber, bus bar

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chamber and CT chamber. Instrument panel is a separate low voltage chamber and shall be supplied with different type of protection relays, Instruments like Meters, Transducers, etc., Moving portion comprises of wheel-mounted truck fitted with an operating mechanism, vacuum interrupters & isolating contacts.

1.13.3.2. Refer BoQ for details of different types of HT Switchgears -11kV /3.3 kV & Generator / Transformer Control / Relay Panels and other Control Panels including DAVR etc.

1.13.4. **Scope of work for HT Switchgear board & Generator / Transformer Control / Relay Panels and other control panels like DAVR etc.,**

- a. The scope of work shall include receipt of panels, accessories & spares including rubber mats from site stores/yard, inspection, handling of accessories between stores and erection location, storage, erection of accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over.
- b. The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. Wherever the base channels are not available, the same shall be fabricated, erected and painted at site. The material for this shall be supplied by BHEL. Base channels shall be grouted on the opening of the floor. If grouting bolts are required for the panel, the same shall be supplied within the quoted rate. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If base frame is to be fabricated, separate rate shall be paid on Tonnage basis. Contractor to arrange Anchor bolts if required.
- c. For the panels to be mounted on the trenches, channel supports shall be provided across the cable trenches over which the base frames of the panels shall be mounted. Support structures if required shall be fabricated and separate rate on Tonnage basis shall be paid for the fabrication.
- d. Panels shall be delivered in different shipping sections. Necessary interconnection of bus bar, inter panel wiring, etc. shall be carried out as part of panel erection.
- e. The contractor shall set each section of equipment on its foundation or supporting structures. The contractor shall assemble equipment as required. Skilled craftsmen arranged by the contractor shall install all equipment with parallel, horizontal and vertical alignment.
- f. Generally, the panels shall be supplied with complete Relays/ Instruments and other Components mounted and wired. However, any minor modifications like dismantling of the existing Relays/ Instruments/Components and mounting of new Relays/ instruments /components and rewiring to suit operating conditions, shall be carried out without any extra cost. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra works basis. Similarly, if any Relays/ Instruments /component supplied as loose for safety transit,

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same shall be mounted and wired as per site requirement at free of cost as part of scope of the job. However, if the loose supplied Relays/ Instruments/Components are more than 10% of the total quantity, the same shall be carried out at extra works basis. Decision of site engineer shall be final regarding such extra works.

- g. The commissioning of Switchgear shall also involve the trial runs and commissioning of all connected equipment like motors and Service Transformer. The contractor shall have to keep their people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc. required in the equipment erected by them. (Separate rate shall be paid for commissioning of associated electrical drives as per BOM). Contractor has to co-ordinate with C&I contractors to make the interconnecting cables through.
- h. The contractor shall do touch up painting of switchgear panels wherever necessary. This includes supply of paint also.
- i. All T&P, Material handling equipment including cranes, Relay Testing/ HV Testing/ Calibration Instruments, primary/secondary injection kits, CRO, frequency counter etc. shall be arranged by the contractor.
- j. Subject to availability, BHEL shall provide EOT cranes for the purpose of shifting the panels within the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P.
- k. The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc.,
- l. One-time calibration shall be carried out for Energy meters in NABL accredited lab if required within the quoted price.
- m. Initial loading of software and programming required by proprietary type microprocessor-based instruments and protection relays will be done by Original Equipment Manufacturer (OEM). Further injections such as Primary and Secondary injection shall be done by contractor. However overall responsibility lies with the contractor and the contractor shall provide all support like manpower, standard T&P, Instruments etc for calibration and commissioning of above proprietary type instruments.
- n. The contractor shall carry out testing and commissioning works with their own testing equipment and testing teams under the supervision of BHEL/Customer Engineers.
- o. All testing Instruments/ Equipment deployed to site shall be calibrated before putting it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for their verification and approval.
- p. Switchboards incomer bus may be cables/ connected to SP bus ducts through adapter box. The contractor shall co-ordinate for proper bus bar connection. Any

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modification required in the bus conductor for matching SP bus duct bus bar shall be carried out without extra cost.

- q. The contractor shall co-ordinate with cable jointer and other LT cable-laying agency for proper cable termination and also during HV testing of cable.
- r. Contractor shall prepare all erection/ commissioning log sheets, protocols/test certificates as per field quality plan, get it signed by the concerned BHEL/ CUSTOMER Engineer and submit the same to BHEL Engineer as per their instruction.
- s. The charged and commissioned equipment shall be maintained by the contractor till the same is taken over by Customer.
- t. Any items like lamps, lens, fuse/relays/instruments missed/ damaged from the custody of the contractor shall be replaced by the contractor at their cost. However, in case the damage is not due to reasons attributable to the contractor, BHEL may arrange for free replacement. The decision of BHEL Engineer in charge in this regard will be final and binding.
- u. If any removal/ Re-fixing of contactors/relays becomes necessary for the completion of the system, the same shall be done by the contractor at free of cost.
- v. Rubber mats for switchgear shall be supplied by BHEL, and these shall be laid, wherever required as part of panel erection. However, sufficient quantity of Rubber mats of required voltage level during testing and commissioning of electrical equipment has to be arranged by contractor for safety point of view.
- w. Contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer at no extra cost as part of panel erection.
- x. Scope of work shall also cover drilling of bottom gland plates for cable entry as required.
- y. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments, transducers mounted on the panels.
- z. If panels are supplied with monitor, printers, furniture, controller etc., or any loose items or equipment, the erection of above shall be part of respective panel. No separate rate shall be payable for loose supplied items unless specifically given in the BOQ.
- aa. The contractor shall arrange watch and ward for the equipment under their custody and erected in location against theft and damage by other agencies working on the same area. Contractor shall arrange to paint/stick good quality danger boards where ever required. Required boards shall be arranged by contractor.
- bb. **Note: -**
 - 1. Dimensions & weights indicated in the BOM against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within $\pm 20\%$ shall not be considered for payment. However, for

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variations beyond $\pm 20\%$, 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.

2. Subject to availability, BHEL will provide EOT cranes for the purpose of shifting the panels within the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P. In addition, refer clauses of VOLUME-IA PART – I CHAPTER – V

1.13.5. **BUS DUCTS:**

BHEL will supply two types of bus ducts as detailed below.

- a) HT Isolated Phase Bus ducts from Generator to single phase Generator Transformers. (Main & Delta)
- b) HT isolated phase bus ducts –Tap off from main to unit / station transformers.
- c) HT segregated phase bus ducts (11kV / 3.3 kV) between
 - i. Unit Transformer to HT switch boards
 - ii. Unit switch boards to station switch boards
 - iii. Station Transformer to station switch boards
 - iv. Unit Aux Transformer to HT switch boards
 - v. Station Aux transformer to HT switch boards
 - vi. Associated inter connections / Tie bus ducts

REFER BOQ FOR MORE DETAILS

1.13.5.1. **ISOLATED PHASE BUS DUCTS**

1. The isolated phase bus ducts shall be connected to the low voltage side of the generator transformer and generator. The bus consists of cylindrical/box type conductor made of Aluminum alloy supported on post insulators. Flexible connections and expansions joints are provided at terminal and intermediate points to alleviate stresses due to expansion and to arrest vibration. All the CTs shall be mounted inside the bus ducts.
2. Isolated phase taps connect the potential transformer, surge protection equipment and unit transformer to the main bus. Each phase of protection equipment and potential transformers shall be housed in metal clad cubicles. Delta formation is carried out through delta bus duct.
3. A totally enclosed neutral grounding cubicle is provided to connect the Generator neutral point. The neutral grounding cubicle houses neutral grounding transformer & resistors.
4. Air pressurization equipment unit and Hot air blowing equipment will be supplied with the generator-isolated bus ducts.
5. BHEL will supply one set of shorting bars for generator dry out.

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6. The tentative details of bus ducts are as under:
 1. Rated Voltage: 27 kV
 2. Highest System voltage: 36 kV
 3. Type of Bus bar joints: bolted / aluminum welded
 7. Any minor drilling or aluminum welding works required at generator end for bolting arrangement of Bellow shall be in the scope of the contractor within the quoted rate.
- 1.13.5.2. **SPVT Cubicle**
SPVT Cubicle will be of draw out type with VT mounted on trolleys, complete with accessories like space heater, bus bars, mounting insulators, marshalling box, etc., Each set shall comprise of the following:
- a. Single phase dry VT 9 Nos.
 - b. Surge Capacitor (24 KV, 0.125 micro Farad) 9 Nos
- 1.13.5.3. **LAVT Cubicle**
LAVT Cubicle will be of draw out type with VT mounted on trolleys, complete with accessories like space heater, bus bars, mounting insulators, marshalling box, etc., Each set shall comprise of the following:
- a. Single phase dry VT 3 Nos.
 - b. Lightning Arrestor (36 kV, 10 kA) 3 Nos.
- 1.13.5.4. **NG Cubicle**
NG Cubicle will be supplied with space heater, bus bars, mounting insulators, marshalling box, etc., and shall house the following:
- a. Dry type epoxy cast NG transformer - 1 No.
 - b. Punched Grid type NG Resistor – 1 No.
- 1.13.5.5. **Bus Duct Supporting Structure**
Bus duct supports will be supplied in pre-fabricated condition.

In case any additional supports are required, contractor has to fabricate and erect from raw material supplied by BHEL and contractor will be paid as per the rates quoted for the structure fabrication and erection in the BOQ.

Bus duct supporting structure fabrication from standard steel section involves welding / bolting and hot dip galvanizing. All structure hardware shall be HTS hot dipped / electro-galvanized.
- 1.13.5.6. **SEGREGATED PHASE HT BUS DUCTS (SPBD)**
BHEL will supply 11 KV/ 3.3 KV Segregated phase bus duct complete with Aluminum alloy enclosure and conductor, epoxy resin bus support insulator arrangement, rubber bellows, inspection windows etc. All bolted joints shall have high tensile steel hardware which shall be cadmium plated/ zinc plated and passivated. All conductor bolted joints shall be silver plated.

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SP Bus ducts shall be connected to LT side of Station Transformer, Unit Transformer, UAT, SAT, HT Switchboards and associated interconnection etc.,

The tentative details of bus ducts are as under:

Insulation level: 28 kV for 11KV SP

10KV for 3.3KV SP

1.13.5.7. **BUS DUCT SUPPORTING STRUCTURES**

Each set of bus duct supports is supplied with hot dip galvanized / standard steel sections supporting structure and shall be erected as per drawings. Any additional supports if required shall be fabricated and erected at site. The required material shall be supplied by BHEL free of cost and the further processing like fabrication, zinc phosphate painting; erection shall be carried out by the contractor without any extra cost.

In case any additional supports are required, contractor has to fabricate and erect from raw material supplied by BHEL and contractor will be paid as per the rates quoted for the structure fabrication and erection in the BOQ.

1.13.5.8. **SCOPE OF WORKS FOR ERECTION & COMMISSIONING OF BUS DUCTS**

The general scope of works for Isolated/Segregated Phase Bus duct is Receipt from BHEL stores/yards, unloading all the bus duct materials and accessories and equipment as indicated in the BOM and relevant drawings at the area where the bus ducts are to be erected, inspection, installation of all the materials, testing and commissioning of total bus duct items, Final Painting and handing over.

Dimensions & weights indicated in the specification / BOM indicated for isolated / segregated phase bus ducts is only approximate. The relevant drawings are enclosed for the purpose of tendering. The contractor has to ascertain the quantum of work involved and quote the lump sum value as called for in the rate schedule.

There may be variations in the weight and dimensions. Any variation in the length of Bus ducts within $\pm 10\%$ shall not be considered for payment. However, for variations beyond $\pm 10\%$, payment shall be considered proportional to the length of the Bus ducts. Variations in width or height or weight including support structure shall not be considered for payment.

The rate for SP Bus ducts shall include fabrication of supports also. For SP Bus ducts, payment shall be made as per actual length erected. Variations in width or height or weight including support structure shall not be considered for payment.

Detailed scope of work shall as below:

- a. Transport of Bus ducts and associated items and equipment from BHEL Stores/ yard to erection site. Cleaning of enclosure and conductors, insulators and other panels before assembly and erection.
- b. Placement of embedment and erection and alignment of steel support structures.

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- c. Assembly and checking of bus duct at ground level if necessary.
- d. Fixing of wall bushings/wall frame assembly
- e. Providing earthing connections as per site conditions.
- f. Minor civil work such as chipping and drilling holes on concrete if necessary and grouting of bus duct support structures including supply of materials required for civil works.
- g. Carrying out required level of cleaning inside as well as outside of the bus duct for the purpose of conducting high voltage test before commissioning of the unit.
- h. Grouting of bus duct and support structures and connecting to earth grid /earth pits as detailed in the relevant bus duct drawings.
- i. Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost.(Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures)
- j. Extension of embedment if required and erection of required supports structures as detailed in the drawing.
- k. Tightening of all bolts in the joints and flanges by torque wrench to the approved pressure (Anti oxidation compound is to be used for joints and it is in the scope of contractor)
- l. Conducting air-tightness test after erection to meet the requirement of BHEL/Customer Standards.
- m. Rectification of leakage, if any without any extra charges- For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, Rota meters etc., at their cost.
- n. Conducting high voltage test for IP/SP bus ducts, short circuit test for IP bus ducts and other tests as per instruction of BHEL engineer after making necessary cleaning inside as well as outside of the bus duct & arranging all testing equipment required for carrying out bus duct testing. Each bus duct pieces will have to be tested for IR value and HV test at working voltage before erection.
- o. Fixing of Space Heaters wiring from space Heaters terminal to junction box, taking through rigid/flexible conduit pipe, Fixing of flexible joints, seal off bushing, rubber bellows, CTs wiring ,conduit/GI pipes breather tapping etc. after testing.
- p. Fixing of Current transformers and wiring from CT terminal to junction box/Marshalling box, taking through rigid/flexible conduit pipe.
- q. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.
- r. Arranging all T&P material handling equipment required for erection, except those arranged by BHEL.

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- s. Calibration of all inspection, measuring and test equipment (IMTEs) before using.
- t. Minor Drilling / Aluminum welding for matching BUS duct items including seal off bushing enclosure, core, wall frame assembly, CT, termination at transformer end shall be carried out without any extra cost.
- u. Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.
- v. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL/Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.
- w. Maintaining the equipment after commissioning till taken over by customer.
- x. Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer VOLUME-IA PART – I CHAPTER – XVI (Painting). Name of the equipment shall be painted boldly as per the instruction of site engineer. Any danger boards required to be displayed shall be arranged by the contractor.

1.13.5.9. **SCOPE OF WORK SPECIFIC FOR ISOLATED PHASE BUS DUCTS:**

- 1. Erection and commissioning of NG cubicle with all its accessories
- 2. Assembly, erection and commissioning of SPVT cubicles with its equipment such as lightning arrestors, voltage transformers, fuses, etc.,
- 3. Erection and alignment of TAP OFF bus ducts for unit transformer, SPVT cubicle etc and formation of Delta at LT side of single phase GTs.
- 4. Erection and commissioning of Air Blower/drier equipment with all the accessories.
- 5. Erection and commissioning of air pressurization equipment with all the accessories.
- 6. Carrying out aluminum welding for bus conductor and on enclosure as detailed in the drawing using MIG/TIG machine with the Aluminum filler wire as per BHEL specification.
- 7. Providing of MIG/TIG welding machine, aluminum filler wire, Argon gas of high purity and other required consumables as per BHEL standard for efficient aluminum welding, covering supporting insulators with asbestos cloth whenever aluminum welding is carried out near the supporting insulator.
- 8. Making necessary modifications of make-up pieces, if required, and welding of isolated phase bus ducts along with NGT, SPVT cubicle, UT tap-offs and delta connections.
- 9. Conducting 10 % X-Ray and 100 % DPT test and arranging the required X-Ray and NDT equipment.
- 10. Providing well-experienced Aluminum welder to meet the radiography quality.

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11. Fixing of neutral side flexible connections to generator and position of neutral CTs after testing.
12. Grouting of bus duct support structures
13. Grouting the ground bus provided on the entire length of entire length of bus ducts, all parts of supporting structures and one end of each enclosure.
14. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.
15. Arranging all T&P material handling equipment required for erection.
16. Calibration of all inspection, measuring and test equipment (IMTEs) before using.
17. Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.
18. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL / Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.
19. Minor Drilling / Aluminum welding for matching BUS duct items including seal off bushing enclosure, core, wall frame assembly, CT, termination at transformer end shall be carried out without any extra cost.
20. Other requirement for Erection/Commissioning of IP Bus ducts.
 - a. Aluminum welders shall appear for test as directed by the BHEL welding Engineer and only test qualified welders shall be permitted to do the welding.
 - b. For MIG/TIG welding only high purity argon gas shall be used. If the contractor is unable to arrange the required high purity Argon gas, the same shall be arranged by BHEL on chargeable basis. The cost of gas shall be recovered from the running bills as per BHEL norms.
 - c. Aluminum filler wire/rod shall be procured in consultation with BHEL Welding Engineer from approved Vendors of BHEL.
 - d. Make up pieces shall be supplied along with bus ducts. Necessary MIG/TIG welding of different sections of enclosures, make up pieces and bus will be carried out at site.
 - e. Holes on the flanges may not be adequate or may not match and any additional holes required same shall be drilled at site to facilitate matching of bus duct enclosure flanges including generator flange within the quoted rate.
 - f. Connecting the Bus duct with other equipment erected by other agencies is in the scope of Bus duct erection.
 - g. Any minor modification required in the bus conductor/enclosure of the bus duct for matching the switch gear in-comer and transformer adopted box shall be carried out without additional cost.

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1.13.5.10. SCOPE OF WORK FOR HT CABLES

- 1.13.5.10.1.** BHEL will supply HT cables (armoured / unarmoured, Aluminium/ Copper) and Instrumentation cables of different sizes and also Termination Kits/ Joint Kits for HT cables.
- 1.13.5.10.2.** 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.
- 1.13.5.10.3.** The unit rate for laying of HT cables shall also include fixing of Trefoil clamps and clamping as per BHEL specification. Separate rate shall be applicable for installation of HT Termination/ Joint Kits as indicated in Rate Schedule.
- 1.13.5.10.4.** Termination of HT cable shall be treated as part of installation of HT termination kits and separate rate shall be applicable for the same.
- 1.13.5.10.5.** For all other cables, a composite rate covering laying and termination shall be applicable.
- 1.13.5.10.6.** Unit rate quoted for cable shall cover laying, 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.
- 1.13.5.10.7.** 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 up to 2.5 sq. mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed in general guide lines.
- 1.13.5.10.8.** Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.,
- 1.13.5.10.9.** Ethernet cables shall be isolated from other cables and laid in a separate cable tray as directed by site Engineer.
- 1.13.5.10.10.** The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. For cable joining, if any, separate rate shall be considered on extra works basis.
- 1.13.5.10.11.** 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.
- 1.13.5.10.12.** Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.
- 1.13.5.10.13.** During testing and commissioning, if the equipment on which the cables are terminated 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 their supervisor or

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technicians to assist the commissioning agencies to check the interconnecting cables.

1.13.5.10.14. 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.

1.13.5.10.15. 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.

1.13.5.11. SCOPE OF CABLE TERMINATION

1.13.5.11.1. The scope of termination shall include termination of cables on various equipment installed by others.

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

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

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

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

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

1.13.5.12. SCOPE OF WORK FOR FABRICATION OF STEEL MATERIALS

1. Scope of fabrication and installation covers, fabrication and installation of various type of supports for cable tray, Junction Box/Panel, bus ducts etc., with angles and channels of different size.
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.
3. Any minor chipping as required as detailed in VOLUME-IA PART –I CHAPTER -XI, including supply of all cement, sand etc. as required for grouting of supports are in the scope of contractor, the same shall be carried out at free of cost. After installation of frames, supports the grouting of the same is in the scope of contractor.
4. If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost.
5. For fixing frames or support if any minor grouting is required the same shall be carried out by the contractor. After installation of frames, grouting of the same is in the scope of contractor.
6. A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be

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paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required.

1.13.5.13. **SCOPE OF CIVIL WORKS**

1. In addition to the scope of works as detailed in VOLUME-IA PART –I CHAPTER –XI, the following scope of civil works shall be carried out by the bidder within the quoted price. Minor civil works like drilling, chipping for transformer /bus duct foundations and punching & opening in concrete floors, slabs, brick walls, grouting of bus duct columns, base frame of panels, Transformer etc. including supply of cement, sand, concrete etc., cleaning of all debris due to electrical installation.
2. The scope of civil works includes supply of grouting materials like grouting cement, sand etc., and cleaning of all debris.
3. No separate payment will be applicable for above civil works.

1.13.5.14. **SCOPE OF CALIBRATION**

1. Contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, Recorders, Indicators etc. that will be supplied along with equipment mounted in or in loose.
2. Contractor shall maintain calibration records as per the BHEL prescribed format.
3. All testing Instruments/ Equipment deployed for calibration shall be calibrated before taking it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for their verification and approval.
4. All testing instruments shall have calibration certificate issued by recognized/accredited agencies.
5. Contractor has to calibrate all the instruments covered in their scope and maintain the calibration records as per the relevant FQP formats.
6. Initial loading of software and programming required by proprietary type microprocessor based instruments and protection relays will be done by Original Equipment Manufacturer (OEM). Further injections such as Primary and Secondary injection shall be done by contractor. However overall responsibility lies with the contractor and the contractor shall provide all support like manpower, standard T&P, Instruments etc for calibration and commissioning of above proprietary type instruments.
7. If BHEL is unable to provide or arrange OEM support for above mentioned proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out

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by 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 within the quoted rate.

1.13.5.15. **LUMP SUM UNIT RATE**

Unit rate to be quoted on lump sum basis 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. No separate rate shall be payable for loose items. The quantities of loose supplied items are approximate only. No proportional rate will be applicable for any variation in quantity or for any additional items supplied as part of equipment.

1.13.6. **SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY OTHER CONTRACTOR.**

1.13.6.1. ALL TYPES OF HT DRIVES AND GENERATOR

- a. Cable identification, checking and meggering.
- b. IR value of motor, measurement of winding resistance etc.
- c. Measurement of Inductance and capacitance of winding
- d. Dry out all the motors if required to improve IR value.
- e. Checking direction of rotation of motors and testing and commissioning from local as well as remote.
- f. Checking the bushing and HV test/Tan delta test
- g. Attending to any defects till the handing over of the unit to customer

Note: For the purpose of successful commissioning of the HT Drives and Generators erected by other contractors, any peripheral Electrical item needs to be erected shall be carried out by the bidder within the quoted rates.

1.13.6.2. **PANELS**

The panels shall be mostly skid mounted and the skid will be erected by mechanical contractor. The scope of commissioning of Panels covers checking of internal wiring and associated loop cables from panels to field instruments, Push Buttons, JB's, drives, replacing defective components/instruments/electronic cards etc.

If any loop cables (power or control) are to be laid or replaced, the same shall be carried out at unit rates available in the BOQ.

For commissioning of associated drives, if any, the unit rate will be as per BOQ and this will not be part of panel commissioning.

NOTE:

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

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

1.13.7. **RIGID & FLEXIBLE CONDUITS**

- 1.13.7.1. Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe/flexible conduits shall be used as per instruction of BHEL Engineer.
- 1.13.7.2. The scope of works 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. The supply of suitable clamps, fasteners and tag plates are in contractor's scope.

1.13.8. **SCOPE OF WORK OF JUNCTION BOXES/ MARSHALLING BOX/STARTER BOXES AND PUSH BUTTON BOXES:**

- 1.13.8.1. Different type of Electrical Junction boxes/Push button boxes shall be supplied. The scope of installation of Junction boxes/Push button boxes shall be as follows:
 - a. The unit rate quoted for erection of junction boxes/push button boxes shall include providing necessary supports, drilling of bottom gland plates for cable glands as required, Painting the tag No of JB or fixing a separate tag plate as required on junction boxes/push button boxes, minor chipping, grouting as required for mounting the JB/PB and supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button.
 - b. Fabrication and fixing of supports shall be on tonnage basis.
 - c. The contractor shall close all unused holes on the gland plates using GROMMET or other suitable material issued by BHEL, within the quoted rate.
 - d. All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.
 - e. If any intermediate JB's are required to terminate power cables for drives, the same shall be installed and also any modification like replacement of terminals, enlarging gland holes etc. required to accommodate power cables shall be carried out as part of this works.
 - f. Equivalent Unit rate shall be paid for installation of such JB's. Decision of site engineer will be final regarding the equivalent rate.

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1.13.9. **SCOPE OF ABOVE GROUND EARTHING & LIGHTNING PROTECTION**

- 1.13.9.1. Earthing scope also covers, earthing of all cable trays, metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, Transformer, Bus ducts, panels, motors, JB, push button boxes etc as required.
- 1.13.9.2. Drawings of main earth grid to be provided by others would be made available to the contractor to enable them to carry out rest of the earthing system work.
- 1.13.9.3. Different type of earthing materials shall be supplied by BHEL and the contractor shall lay and connect the earthing materials as per site requirement. Unit rate for earthing material shall be paid on meter basis if appearing in the BOQ.
- 1.13.9.4. The connection between earthing pads/ terminal to the earth grid shall be made short and direct and shall be free from kinks and splices.
- 1.13.9.5. Generator neutral from the NGT/NGR cubicle shall be earthed using two dedicated rod electrodes, which shall in turn be connected to the main plant grid.
- 1.13.9.6. Installation of treated earth pit as per IS:3043 including providing concrete chamber with CI cover(hinge type) and nomenclature/identification of the pit. (Only GI pipe & funnel shall be supplied by BHEL)

1.13.10. **SCOPE OF WORK FOR FABRICATION & INSTALLATION OF STEEL MATERIALS**

- 1.13.10.1. Scope of steel fabrication and installation covers, fabrication and installation of various type of supports for Junction Box/Panel, bus ducts etc. with angles and channels of different size
- 1.13.10.2. 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.
- 1.13.10.3. For fixing frames or supports if any minor grouting is required the same shall be carried out by the contractor. After installation of frames, grouting of the same is in the scope of contractor.
- 1.13.10.4. Supply of all cement, sand etc. required for grouting of supports is in the scope of contractor.
- 1.13.10.5. A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required.
- 1.13.10.6. Any minor chipping as required as detailed in VOLUME-IA PART –I CHAPTER -XI, including supply of all cement, sand etc. as required for grouting of supports are in the scope of contractor, the same shall be carried out at free of cost. After

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installation of frames, supports the grouting of the same is in the scope of contractor.

1.13.11. SCOPE OF WORKS FOR LT BUSDUCTS

- 1.13.11.1. LT Bus ducts shall be of Non-segregated Phase Type, rectangular shape, made out of Aluminium enclosure with Aluminium busbar. The Aluminium busbars shall be supported with insulators. LT Busducts are used for connecting LT Transformers and PCC / MCC and will be supplied in different sectional lengths as per layout.
- 1.13.11.2. BHEL will supply necessary busduct supporting materials like GI or MS angle/channels along with bus ducts. The support materials supplied may be either prefabricated or of standard length and the same shall be fabricated and installed as per site requirements.
- 1.13.11.3. The scope of work includes Receipt from BHEL stores/yards, unloading all the busduct materials and accessories and equipment as indicated in the BOM and relevant drawings at the area where the busducts are to be erected, inspection, installation of all the materials, testing and commissioning of total busduct, painting and handing over. Minor civil works like chipping, grouting, including supply of grouting material is also included in the scope of work.
- 1.13.11.4. The unit rate quoted for E&C of bus ducts shall include fabrication and installation and painting of busduct supports (For MS supports if any). No separate rate shall be paid applicable for the same.
- 1.13.11.5. If there is any mismatch or inadequacy of the holes on the bus duct flange, the same shall be drilled at site to facilitate matching of bus duct flange with Transformer or PCC/MCC flanges without any extra cost.
- 1.13.11.6. Length of LT Busducts mentioned in the BOQ is approximate only and payment shall be made as per actual length erected. Variations in width, height and weight (including weight of support structure) will not be considered for payment.
- 1.13.11.7. Placement of embedment and erection and alignment of steel support structures, Assembly of busduct, Fixing of wall bushings/wall frame assembly, providing earthing connections. Minor civil work such as chipping and drilling holes on concrete if necessary, enlarging of pockets in concrete pedestals and grouting of busduct support structures including supply of materials required for civil works. Grouting of bus duct and support structures and connecting to earth grid /earth pits as detailed in the relevant bus duct drawings.
- 1.13.11.8. Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost. (Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures)
- 1.13.11.9. Carrying out required level of cleaning inside as well as outside of the bus duct for the purpose of conducting high voltage test before commissioning of the unit. Every bus duct piece has to be tested for IR value (for 415 Volts bus ducts) and

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- both IR and HV test at rated voltage (for voltage levels above 415 Volts) before erection. This is in addition to the final IR value and HV testing before charging. After long shut downs, the IR value / HV tests will have to be carried out before charging.
- 1.13.11.10. Extension of embedment if required and erection of required supports structures as detailed in the drawing. Tightening of all bolts in the joints and flanges by torque wrench to the approved pressure (Anti oxidation compound will be used for joints which will be arranged by contractor). Conducting air-tightness test after erection to meet the requirement of BHEL/Customer Standards.
 - 1.13.11.11. Rectification of leakage, if any without any extra charges- For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, rotameter etc., at their cost. Contractors shall tap the air from nearest Instruments air tapping point available at site.
 - 1.13.11.12. Fixing of Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe, Fixing of flexible joints, seal off bushing, rubber bellows, CTs wiring, conduit/ GI pipes breather tapping etc., after testing.
 - 1.13.11.13. Fixing of Current transformers and wiring from CT terminal to junction box/Marshalling box, taking through rigid/flexible conduit pipe.
 - 1.13.11.14. Fixing of Space Heaters and wiring from Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe.
 - 1.13.11.15. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.
 - 1.13.11.16. Arranging all T&P material handling equipment required for erection, except those arranged by BHEL.
 - 1.13.11.17. Calibration of all inspection, measuring and test equipment (IMTEs) before using it.
 - 1.13.11.18. Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan (FQP) and getting them signed by BHEL/Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.
 - 1.13.11.19. Maintaining the equipment after commissioning till taken over by Customer.
 - 1.13.11.20. Milli volt drop test is to be carried out for all bolted joints.
 - 1.13.11.21. Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc., as required as part of erection. (For more details, refer scope of painting).
 - 1.13.12. **SCOPE OF WORKS FOR LT SWITCHGEAR, 415 V- POWER MOTOR CONTROL CENTERS (PMCC)/MCC/DISTRIBUTION BOARDS, ELECTRONIC**

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CONTROL PANEL (ECP), BATTERY CHARGER PANEL AND OTHER CONTROL PANELS:

- 1.13.12.1. LT MCCs/PMCCs/MCCs are simple module type with isolators and fuses. However, some of the MCCs are Double Front draw out type consisting of circuit breakers unit, contactors/starter fuse switch units, MCB etc., arranged in multi-tier construction.
- 1.13.12.2. The scope of work shall include receipt of panels, accessories & spares including rubber mats from site stores/yard, inspection, handling of accessories between stores and erection location, storage, erection of accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over.
- 1.13.12.3. The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If grouting bolts are required for the panel, the same shall be supplied by the contractor at no extra cost.
- 1.13.12.4. Wherever the base channels are not available, the same shall be fabricated, erected and painted at site. The material for this shall be supplied by BHEL. If base frame is to be fabricated, separate rate shall be paid on Tonnage basis.
- 1.13.12.5. For the panels 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. The contractor shall carry out fabrication and erection of these support structures. Separate rate shall be paid on Tonnage basis for fabrication and erection of support structures.
- 1.13.12.6. The MCCs will be located in MCC room at any elevation in the Power house, as per plant layout. The LTMSB/ACP/ECP will be located in the ESP control room as per layout. All other panels are located in their respective control rooms. 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.
- 1.13.12.7. Panels will be delivered in different shipping sections. The contractor shall set each section of equipment on its foundation or supporting structures and assemble the panels as required. Necessary interconnection of busbar, inter panel wiring, etc. will have to be done by the contractor.
- 1.13.12.8. Electronic Control Panels (ECP) will be supplied with additional loose items such as Areca Controllers and their accessories. All the items shall be fixed and wired in the panel as per the layout; testing and commissioning shall be as per instructions of the site engineer within the quoted rate. Please also refer the CI.No. 1.13.12.18

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- 1.13.12.9. Generally the panels shall be supplied with complete Relays/ Instruments and other Components mounted and wired. However, if necessary, dismantling of the existing Relays/ Instruments/ Components, making minor modifications in wiring to suit operating conditions, mounting and wiring of new Relays/ instruments / components shall be carried out without any extra cost. Mounting and wiring of any instruments, meters, relays, push buttons, indicating lamps, contactors etc., if supplied loose for safety in transit, shall also be included in the scope of the job. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra cost. The decision of BHEL Engineer shall be final in respect of above extra works.
- 1.13.12.10. The contractor shall do touch up painting of switchgear panels wherever necessary including supply of paints within the quoted rate.
- 1.13.12.11. The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc., with well experienced Engineers/ Technicians.
- 1.13.12.12. MCC/PCC incomer bus shall be connected to main source/PCC of customer. The contractor shall co-ordinate for proper connection at both ends.
- 1.13.12.13. Erection of Resistance box of DC drives shall be part of erection of DC starter panels.
- 1.13.12.14. Scope of work shall include drilling of bottom gland plates for cable entry for all the cables to be terminated on the panel, as per requirement.
- 1.13.12.15. Contractor shall co-ordinate with other cable-laying agency for proper cable termination.
- 1.13.12.16. The contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer as part of panel erection.
- 1.13.12.17. Rubber mats for Switchgear shall be supplied by BHEL, and these shall be laid, wherever required, by the contractor.
- 1.13.12.18. If panels are supplied with monitor, printers, furniture, controller etc. or any loose items or equipments, the erection of above shall be part of respective panel. No separate rate shall be payable for loose supplied items unless specifically indicated in the BOQ.
- 1.13.12.19. The scope of work shall include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels.
- 1.13.12.20. In certain cases, Switchboards incomer bus shall be connected to busducts, through adapter box. The contractor shall co-ordinate for proper busbar connection. If any modification is required in the bus conductor for matching busduct busbar, the same shall be carried out without extra cost.
- 1.13.12.21. The commissioning of Switchgear shall also involve the trial runs and commissioning of all connected equipment like servomotors and drives etc., The

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contractor will have to keep his people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc., required in the equipment erected by him. (Separate rate shall be paid for commissioning of associated electrical drives as per Rate Schedule only once for an equipment). Contractor shall re-commission the equipments once commissioned by him in case a need arises. Contractor will not be paid commissioning charges more than once for same equipment. Commissioning engineers / supervisors with other technicians, helpers as required will have to come in shifts during commissioning of plant as per BHEL's requirement.

- 1.13.12.22. All T&P, Material handling equipment including cranes and Relay Testing/ HV Testing Calibration equipment/ Instruments shall be arranged by contractor.
- 1.13.12.23. All testing Instruments/ Equipment deployed to site shall be calibrated before putting the same into service. A copy of calibration certificate shall be submitted to BHEL Engineer for his verification and approval.
- 1.13.12.24. Contractor shall prepare all erection/ commissioning log sheets, protocols/test certificates as per field quality plan, get it signed by the concerned BHEL/ Customer Engineer and submit the same to BHEL Engineer as per his instruction.
- 1.13.12.25. The contractor shall maintain the charged and commissioned equipment till the same is taken over by customer.
- 1.13.12.26. If any removal/ Re-fixing of contactors/relays become necessary for the completion of the system, the same shall be done by the contractor at no extra cost.
- 1.13.12.27. Contractor shall put his watch and ward for the equipment under his custody and erected in location against theft and damage by other agencies working on the same area.
- 1.13.12.28. Any loose supplied items like lamps, lens, contactor, fuse/relays/instruments etc., missed from the custody of the contractor shall be replaced by the contractor at no extra cost.
- 1.13.12.29. Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Variations in depth, height or weight of the panel shall not be considered for payment. Any variation in length within $\pm 20\%$ shall not be considered for payment. If the panels have any variation in length beyond $\pm 20\%$ as compared to actual length indicated in the BOQ, payment shall be considered proportional to the length of the panel only.
- 1.13.12.30. BHEL shall provide vendors' support for commissioning of proprietary type of microprocessor based instruments, protection relays which require software loading and programmer etc. However overall responsibility lies with contractor and the contractor shall provide all support like manpower, standard T&P,

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instruments etc. for calibration and commissioning of above proprietary type instruments.

1.13.12.31. The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams. Testing shall be done under the supervision of BHEL/Customer Engineers.

1.13.12.32. Subject to availability, BHEL shall provide EOT crane for the purpose of shifting the panels with in the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P.

1.13.13. **SCOPE OF WORKS FOR BATTERY AND BATTERY CHARGER:**

1.13.13.1. **GENERAL:**

A. The charger and batteries are of heavy duty type, capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden stands. Tentative details are given in the BOM.

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

C. Lumpsum shall be quoted for Erection and commissioning of Battery. No additional payment shall be made for any variation in the number of cells. The rate quoted for erection of battery will include the following works.

1.13.13.2. Collecting the batteries and all the accessories like cable connectors, inter cell connectors, equalizing connectors, rack insulators, fuse box, loop cables etc. from stores and assembling on the racks and fixing all loose supplied items as per drawings.

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

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

1.13.13.5. 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/Vendor Engineer.

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

1.13.13.7. Arranging necessary tools, T&P, Testing equipments required for erection and commissioning of the battery.

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

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1.13.14. **SCOPE OF WORK FOR BATTERY CHARGER PANELS:**

The scope of work will be in line with scope of work for electrical control panels, as detailed elsewhere in this specification.

1.13.15. **SCOPE OF WORK FOR DIESEL GENERATOR SET**

- 1.13.15.1. The DG sets of rating 2000 KVA (e), 3 phase, 415 V set with diesel engine, AVR, Radiator ,Air Intake System, Exhaust system, Fuel Day Tank, battery sets, Acoustic enclosure, panels etc.,
- 1.13.15.2. Cooling system comprising of radiators, engine mounted water pump, self-contained pipe, thermostat etc.
- 1.13.15.3. **Fuel system** consisting of PT fuel pump, injectors, fuel filters, self-contained piping.
- 1.13.15.4. **Lubricating system** consisting of oil pumps, strainers, lube oil cooler, bypass filter, self-contained piping.
- 1.13.15.5. Air Intake System consisting of dry type filter, air intake manifold with necessary connectors, turbo charger with after cooler.
- 1.13.15.6. Exhaust system consisting of exhaust manifold, flexible piping, residential silencer etc.
- 1.13.15.7. The scope of works covers erection of Diesel Generator and erection of all loose supplied items, Acoustic treatment/insulation as detailed in BOM and as per BHEL drawing.
- 1.13.15.8. Minor civil works like drilling, chipping and punching holes and opening in concrete floors, slabs, brick-walls, and cleaning of all debris, Grouting, supply of cement, sand, concrete etc. required for installation of DG sets shall be included in the erection cost of equipment. No separate payment is applicable.
- 1.13.15.9. If any major civil foundations/modifications/alterations are required for proper installation of Diesel Generator, the same shall be carried out at extra cost. The decision of BHEL Engineer regarding the above will be final.
- 1.13.15.10. All T&P, material handling equipments, including crane shall be arranged by the contractor.
- 1.13.15.11. All calibration and testing instruments required for relay testing, high voltage testing and load testing shall be arranged by the contractor.
- 1.13.15.12. Separate rate shall be applicable for Erection of cable trays, loop cabling between Diesel Generator to Control Panel/MCC and between Control Panel to MCC as indicated in Rate Schedule.
- 1.13.15.13. Obtaining explosive license (if applicable) shall be under the scope of the contractor.
- 1.13.15.14. Fuel filling in DG till handing over is included in the scope of the vendor. Fuel shall be supplied by BHEL.

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1.13.15.15. Supervision during Erection, Pre-Commissioning Checks, Commissioning, Load trials of DG sets and accessories AND also during PG Test of DG Sets and Accessories shall be carried out by the OEM.

1.13.15.16. **The DG set shall be maintained by the contractor after commissioning until full load testing is completed.**

1.13.16. SCOPE OF WORK FOR LT CABLES LAYING

1.13.16.1. BHEL will supply LT cables (1.1 kV, Armoured / Unarmoured, Aluminium / Copper XLPE/PVC insulated) of different sizes. (Power, control and instrumentation cable).

1.13.16.2. 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. All cables shall be identified at both ends, adjacent to the cable glands. In addition, cable shall be identified at all drop / pull pits, manholes, pull boxes, and at major changes of direction in cables tray / trenches and multilayer racking cable routes.

1.13.16.3. Unit rates shall be on meter basis. Unit rate quoted for cable shall cover laying, 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.

1.13.16.4. Unit rates quoted for cabling shall also include supply of clamping / dressing materials such as Aluminium / GI strips and PVC ties, PVC wire marker sleeves, tag plates, lugs upto 2.5 sq. mm. apart from the work mentioned above. The lugs being used shall be of standard make and shall be procured after getting prior approval of the brand from BHEL engineer. Usage of any other lugs shall entail replacement of the lugs by the contractor at his risk and cost. Supply of above material shall conform to the specification detailed in Volume-IA Part-II Chapter-3. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.,

1.13.16.5. For single core Power cable, fixing of Trefoil clamps shall be treated as part of laying work.

1.13.16.6. If the cables are to be routed on steel angles as per site condition, steel angles will be supplied by BHEL.

1.13.16.7. The contractor shall carry out cable dressing and clamping for all the cables laid by him. However, if cables like illumination cables or any other cables of lesser quantity for which no separate trays have been allotted and are to be laid on the same trays, the contractor shall do clamping of such cables also along with the cables laid by him.

1.13.16.8. Single core cable used for three phase AC power shall be clamped in trefoil cable at the time of laying itself.

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- 1.13.16.9. The unit rate quoted for cable laying shall also cover the following works.
- a. The end termination of cable sizes upto 2.5 sqmm including supply of lugs as required.
 - b. Enlargement of cable entry holes, if necessary, by chipping/tapping or any modification required fixing of cable glands.
 - c. Reaming and relocating holes at actual point of entry of cable or conduit in terminal boxes, outlet boxes, pull boxes etc., cleaning off the debris/trapped material from conduit/ducts.
- 1.13.16.10. In case any existing structure is affected/damaged due to installation work of cables the contractor shall repair the same to the satisfaction of Site Engineer.
- 1.13.16.11. However any major modification like drilling, tapping etc. are involved in fixing of glands in JB's and Terminal boxes same shall be considered as extra on man hour rate basis as per extra works clause.
- 1.13.16.12. Minor chipping of concrete floor cutout below panels in order to align the panel's gland plate with the floor cutout shall be done without any extra cost by the contractor.
- 1.13.17. **SCOPE OF WORK FOR CABLES TERMINATION**
- 1.13.17.1. The scope of termination shall include termination of cables on various panels / JB's / Push buttons etc. installed by others also. The contractor shall co-ordinate with such agencies and do the termination, including drilling of gland plates for fixing cable glands, if required.
- 1.13.17.2. Re-termination if required during testing / commissioning shall be carried out without additional cost.
- 1.13.17.3. Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant and long enough to over pass conductor insulation.
- 1.13.17.4. Contractor shall arrange all type of termination and crimping Tools / equipment required for the connections / terminations.
- 1.13.17.5. Contractor should use sleeve printers for printing sleeve as wire markers. Cut ferrules will not be permitted to be used. Cross ferruling shall be done for all wire terminations.
- 1.13.17.6. After cable terminations, the debris shall be removed then & there.
- 1.13.17.7. Necessary lugs above 2.5 sq. mm shall be supplied by BHEL free of cost.
- 1.13.17.8. Separate rate shall be paid for termination of higher size cables more than 2.5 sqmm. Such cables will be indicated separately in the BOQ/ Rate Schedule.

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1.13.18. **SCOPE OF WORK FOR CABLE TRAYS & SUPPORTS**

- 1.13.18.1. Scope of cable tray works covers erection various sizes of ladder & perforated trays with tray accessories such as bends(vertical and Horizontal), tees, cross, reducers, coupler plates, fasteners etc.
- 1.13.18.2. The scope of erection shall also covers erection all type of trays and its accessories such as coupler plates/fixing plates, anchor bolts, fasteners, Tees, Reducers, Bends (vertical and Horizontal), cross etc.,
- 1.13.18.3. If accessories such as Tees, Reducers, Bends (vertical and Horizontal), cross not supplied, same shall be fabricated wherever required, from the straight Trays. The accessories supplied may be modified to suit site routing as part of work.
- 1.13.18.4. The scope also covers making offsets by means of cutting standard tray sections and inserting suitable size of trays to match with the existing arrangement.
- 1.13.18.5. The unit rate for erection of trays shall be on meter basis which includes erection of trays and accessories, fabrication of trays accessories and modification of straight trays, if required.
- 1.13.18.6. No separate rate shall be paid for any fabrication of tray accessories or any modification on straight trays.
- 1.13.18.7. If trays covers are supplied same shall 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.
- 1.13.18.8. 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.
- 1.13.18.9. Cable tray mounting structure shall be welded to the plate inserts or to steel structural beams/ members. Welding of cable tray mounting structure to steel structural beams/ members shall be done with prior approval of Customer/ BHEL Engineer. Cable tray tag number shall be painted on trays.

1.13.19. **SCOPE OF WORK FOR RIGID & FLEXIBLE CONDUITS (AS APPLICABLE):**

- 1.13.19.1. Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe/flexible conduits shall be used as per instruction of BHEL Site Engineer.
- 1.13.19.2. The scope of works 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. The supply of suitable clamps, fasteners and tag plates are in contractor's scope.

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1.13.20. **LIGHTNING PROTECTION SYSTEM INSTALLATION**

- 1.13.20.1. The scope of works for Lightning Protection system includes installation of vertical air terminations, Horizontal conductors, vertical risers, down conductors, test links, earth electrodes, supply of saddles & clamps, minor civil works etc.
- 1.13.20.2. **HORIZONTAL AND VERTICAL DOWN CONDUCTORS:** The horizontal conductors shall be installed on the top of the building with suitable clamps/saddles arrangements. This horizontal conductor shall be connected with down conductors which in turn will be connected to risers through test links. Both horizontal and down conductors shall be supported on the clamps/saddles and spacers which will be fixed on the walls/columns or on top of the parapet walls.
- 1.13.20.3. The scope of work for horizontal and vertical conductor shall include supply of supports, clamps, saddles, spacers, Anchor fasteners etc.
- 1.13.20.4. **TEST LINKS** shall be installed in the vertical down conductors at ground level as shown in the lightning protection drawings. Supply of GI fasteners like washer/bolt/nut required for fixing Test Link and connecting Test Link to earth electrodes through GI Flat by welding also is part of the scope.
- 1.13.20.5. **RISER ROD AND VERTICAL ELECTRODE:** Riser Rod and Vertical Electrode, of 40 mm dia, in standard lengths, will be supplied by BHEL. The vertical rod shall be made from the standard length for 3 Mtr and driven into earth. The riser rod shall be suitably fabricated as per requirement and connected to the down conductor and vertical electrode.
- 1.13.20.6. Excavation of earth for laying of riser rod, welding with vertical electrode and down conductor, refilling of the excavated earth, consolidation etc. shall be part of the work for installation of riser rod. Even if the building plinth area has already been consolidated, the same shall be removed, conductors shall be installed, welded, refilled and consolidated.
- 1.13.20.7. The scope of work for vertical electrode shall cover driving into the earth with suitable tools, and welding to the riser rod, consolidation etc.
- 1.13.20.8. **VERTICAL AIR TERMINATIONS:** The vertical air terminations shall be located in different locations of the buildings. The vertical terminal shall mostly be fixed on the top of peripheral wall using a GI base plate of size 150x150x6 mm. The vertical air terminal shall be grouted on the wall and minor civil works required for grouting the air terminals including supply of grouting materials are in the scope of Contractor.
- 1.13.20.9. Supply of base plates, and related civil works, grouting and supply of grouting materials are part of the scope for vertical air terminations.

1.13.21. **SCOPE OF WORK FOR ASH LEVEL INDICATOR**

- 1.13.21.1. Scope of Ash level indicator consists of erection of transmitters (electronic unit), PTF wires, probes (for high and low level sensing), flexible conduits etc. All PTF

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cables shall be routed through $\frac{3}{4}$ " GI flexible conduits.

- 1.13.21.2. The unit rate derived for each set consists of erection of transmitters (electronic units), fixing of probes, laying and termination of PTF cables through conduits, clamping of flexible conduits etc. The unit rate also covers supply of metallic clamps, lugs etc. Lumpsum rate shall be derived for each set and no separate payment shall be made against erection of any individual item.
- 1.13.21.3. If any mounting frames are required for insulation of transmitters same shall be carried out on tonnage basis as applicable for other fabrication and erection.

1.13.22. **SCOPE FOR C&I WORKS**

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.

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

- 1.13.23.1. 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.
- 1.13.23.2. 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.
- 1.13.23.3. 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 as per rate schedule, on tonnage basis
- 1.13.23.4. 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

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- 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.
- 1.13.23.5. 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.
- 1.13.23.6. 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.
- 1.13.23.7. All the panels and JB's shall be electrically earthed to the nearest earth grid by means of GI wire/Flats as per the instructions of BHEL engineer.
- 1.13.23.8. 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.
- 1.13.23.9. Closing the Panel openings and unused drilled holes with non-flammable sealant materials, including supply of above material, shall be part of erection work.
- 1.13.23.10. 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.
- 1.13.23.11. 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.
- 1.13.23.12. Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within $\pm 20\%$ shall not be considered for payment. However, for variations beyond $\pm 20\%$, payment shall be considered proportional to the length of the panel. Variations in depth, height or weight of the panel shall not be

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considered for payment.

1.13.24. 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 1.13.23.

1.13.25. 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:

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

1.13.25.2. 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.

1.13.25.3. 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

1.13.25.4. 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.

1.13.25.5. 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.

1.13.25.6. 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.

1.13.26. SCOPE OF WORK FOR UPS, BATTERY AND BATTERY CHARGER

1.13.26.1. 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.

1.13.26.2. 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.

1.13.26.3. 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.

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- 1.13.26.3.1. Filling the individual cells with Acid/alkali – if applicable.
- 1.13.26.3.2. Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.
- 1.13.26.3.3. 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.
- 1.13.26.3.4. Modifications or changes if any for the loose supplied items or any minor changes in wiring.
- 1.13.26.3.5. Arranging necessary tools, T&P, testing equipment's required for erection and commissioning of the battery.
- 1.13.26.3.6. For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.

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

- 1.13.27.1. The scope of work will be in line with scope of work for control panels, as detailed under Clause above in 1.13.23.

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

- 1.13.28.1. The type of instruments to be erected and commissioned shall be as detailed below:
 - 1.13.28.1.1. Panel mounted Instruments like indicators, recorder, electronic modules etc.
 - 1.13.28.1.2. All types of transmitters like temperature, pressure, flow, level and position feedback transmitters etc.
 - 1.13.28.1.3. 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.
 - 1.13.28.1.4. Air filter regulator sets, Air lock off valve, Power cylinders etc.
 - 1.13.28.1.5. Panel/ Control desk mounted Instruments like indicators, recorder, console and electronic modules etc.
 - 1.13.28.1.6. I/P converters and local controllers.
 - 1.13.28.1.7. 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.
 - 1.13.28.1.8. Pneumatic operated control valves, trip valves, solenoid valves,

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and electrically operated valves. (commissioning only)

- 1.13.28.2. 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.
- 1.13.28.3. 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.
- 1.13.28.4. 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.
- 1.13.28.5. 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.
- 1.13.28.6. 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.
- 1.13.28.7. 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.
- 1.13.28.8. Unit rate for erection and checking of thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.
- 1.13.28.9. 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.
- 1.13.28.10. 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.

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- 1.13.28.11. 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.
- 1.13.28.12. 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.
- 1.13.28.13. 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.
- 1.13.28.14. 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.
- 1.13.28.15. 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.
- 1.13.28.16. 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.
- 1.13.28.17. Temporary protection by thermocol, polythene sheet, GI sheets shall be provided by the contractor for safe guarding the instruments against damages.

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The protective materials shall be supplied by the contractor at no extra cost.

- 1.13.28.18. 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.
- 1.13.28.19. 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.
- 1.13.28.20. 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 1.13.23
- 1.13.29. **SCOPE OF WORK FOR IMPULSE PIPES:**
 - 1.13.29.1. 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.
 - 1.13.29.2. 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.
 - 1.13.29.3. 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.
 - 1.13.29.4. For longer route lengths of impulse pipes, the contractor shall provide Tag numbers at appropriate locations as directed by BHEL site engineer.
 - 1.13.29.5. Hydraulic test shall be conducted for all impulse pipes after completion of

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erection as per site engineer's directive, as part of the work.

- 1.13.29.6. The contractor shall obtain necessary approval for welding electrodes, filler wire from BHEL welding engineer at site.
- 1.13.29.7. Impulse pipes Welder shall undergo test and get approval from BHEL welding engineer according to the nature of welding.
- 1.13.29.8. Pre-heating before welding and post weld heat treatment (stress relieving) as per the standard is in the scope of the contractor.

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

- 1.13.30.1. 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.
- 1.13.30.2. 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.
- 1.13.30.3. 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.
- 1.13.30.4. 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.

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

- 1.13.31.1. 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.
- 1.13.31.2. 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.
- 1.13.31.3. 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.

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- 1.13.31.4. 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.
- 1.13.32. **SCOPE OF WORK FOR INSTRUMENT AIR LINES (GI PIPES):**
- 1.13.32.1. 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.
- 1.13.32.2. 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.
- 1.13.32.3. 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.
- 1.13.32.4. 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.
- 1.13.33. **SCOPE OF WORK OF ELECTRIC & PNEUMATIC ACTUATORS:**
- 1.13.33.1. 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.
- 1.13.33.2. 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.
- 1.13.33.3. 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

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- 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.
- 1.13.33.4. For calibration of any Pneumatic Actuator at field, temporary air supply if required shall be arranged by the contractor.
- 1.13.33.5. 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.
- 1.13.33.6. 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.
- 1.13.33.7. 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.
- 1.13.34. **SCOPE OF WORK FOR CABLES:**
- 1.13.34.1. 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.
- 1.13.34.2. 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.
- 1.13.34.3. 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.
- 1.13.34.4. 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.
- 1.13.34.5. Unit rates quoted for cabling shall also include supply of clamping/ dressing

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- 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.
- 1.13.34.6. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, underground, cable shafts etc.
- 1.13.34.7. 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.
- 1.13.34.8. 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.
- 1.13.34.9. 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.
- 1.13.34.10. 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.
- 1.13.34.11. Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.
- 1.13.34.12. 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.
- 1.13.34.13. 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.
- 1.13.34.14. 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.
- 1.13.34.15. Any fabrication required at site for cable support shall be carried out at the rate quoted for fabrication.
- 1.13.34.16. Cable installation shall be properly coordinated at site with other services and

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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.

- 1.13.34.17. 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.

1.13.35. SCOPE OF CABLE TERMINATION

- 1.13.35.1. Laying and termination of all cables including Ethernet, fibre optic cable is part of the scope.
- 1.13.35.2. The scope of termination shall include termination of cables on various panels / JB's / Push buttons / equipment etc. including those installed by other agencies.
- 1.13.35.3. Re-termination, if required during testing/ commissioning shall be carried out without additional cost.
- 1.13.35.4. 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.
- 1.13.35.5. Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.
- 1.13.35.6. Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.
- 1.13.35.7. After cable terminations, the debris shall be removed then & there.
- 1.13.35.8. Also refer clause 1.13.34.2 above

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

1.13.36.1. 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.

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- 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.

1.13.36.2. 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.

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

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

1.13.37.2. 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

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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 JB/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.
- 1.13.37.3. All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.
- 1.13.37.4. For CJCBs/ RJCBs, the rate for Junction Boxes similar size, as per Rate Schedule, will be applicable.
- 1.13.37.5. For fabrication and fixing of supports/Frame, rate shall be paid on tonnage basis.
- 1.13.38. **SCOPE OF WORK FOR FABRICATION & ERECTION OF STEEL MATERIALS:**
- 1.13.38.1. 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.
- 1.13.38.2. 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.
- 1.13.38.3. 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.
- 1.13.38.4. All fabricated steel materials shall be painted as detailed in the scope of painting.
- 1.13.38.5. 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.
- 1.13.39. **SCOPE OF EARTHING**
- 1.13.39.1. 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.
- 1.13.39.2. Different type of earthing materials shall be supplied and same shall be erected

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as per site requirement.

- 1.13.39.3. The scope of work shall include supply of fasteners, lugs, minor civil works etc.
- 1.13.39.4. 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.
- 1.13.39.5. 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.

1.13.40. **SCOPE OF CALIBRATION:**

- 1.13.40.1. 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.
- 1.13.40.2. 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.
- 1.13.40.3. 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.
- 1.13.40.4. 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.
- 1.13.40.5. 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.

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

- 1.13.41.1. 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 JB's, 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),

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Commissioning, Installation of software packages, handing over to the end-user are in the scope of OEM).

1.13.42. **CABLE LAYING IN GENERAL:**

- 1.13.42.1. All cables shall be provided with minimum of 2mm thick aluminum sheets as cable identification tags indicating cable designation in accordance with the cable schedule. The cable tags shall be provided at the ends, every 30mtrs and when the cable changes its direction/elevation. The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG GI wire.
- 1.13.42.2. All the cables shall be clamped to the cable trays/support structure with the help of clamps. All power cables shall be clamped individually and control cables shall be clamped in groups of 3 or 4 cables. Clamps for multicore cables shall be fabricated out of 25x3 mm aluminium flats. Single core power cables shall be laid in trefoil formation and suitably clamped with 25mm wide 8 SWG aluminium strips.

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

- 1.13.43.1. 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.
- 1.13.43.2. The measurement for cable, impulse pipes/tubes, GI pipe, conduits, flexible conduits, trays etc. shall be made on the basis of length actually laid.
- 1.13.43.3. 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.
- 1.13.43.4. 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.
- 1.13.43.5. 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.

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- 1.13.43.6. 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.
- 1.13.43.7. 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.
- 1.13.43.8. 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.
- 1.13.43.9. 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.
- (iii) The scope of work also includes collecting the replacement instruments/parts from BHEL/customer stores, stockyard etc.

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

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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

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- 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. Monthly Plan and review will be done as per the Format provided in Form-14. (Any revision in the format during the currency of the contract will also be applicable.)
- 1.14.12. The contractor shall submit any other details like Site Organization chart, Progress photographs, Safety implementation report, pending material and any other inputs required from BHEL for activities planned during the subsequent month, etc. as sought by BHEL Engineer.
- 1.14.13. 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.

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

1.15.1. 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 and in relevant clauses of this TCC.

1.15.1.1. ALL TYPES OF DRIVES AND GENERATOR:

- a. Cable identification, checking and meggering.
- b. IR value of Generator, motor, measurement of winding resistance etc.
- c. Dry out all the motors if required to improve IR value.
- d. Checking direction of rotation of motors and testing and commissioning from local as well as remote.
- e. Checking the bushing and HV test / Tan delta test
- f. Attending to any defects till the handing over of the unit to customer.
- g. Erection of peripheral electrical items required for successful commissioning

1.15.1.2. HIGH VOLTAGE RECTIFIER TRANSFORMER – ESP:

- a. Dry out of transformers (Oil filtration) till achieving desired BDV, IR Value, Calibration of oil temperature gauges, checking of breather gauge, Relays, HV Test etc. i.e. scope of commissioning of ESP Transformer shall be in line with transformers erected by the contractor.
- b. Replacing defective components like temperature gauges, breather glass etc.
- c. Attending to any defects till handing over of the unit to customer by BHEL.
- d. Oil top up if required after first commissioning of ESP, HV transformers till handing over to customer is under the scope of this package.

1.15.1.3. HOIST/MONORAIL/GANTRY CRANE:

- a. Termination of power cable at Junction box & Hoist/Monorail/Gantry Crane control panel. However laying of power cable shall be done by Mechanical agency and payment for the cable termination shall be made by BHEL as per the BOQ rate schedule quoted by contractor.

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- b. Pre-commissioning checks and commissioning of Hoist/Monorail/Gantry Crane. Providing assistance during load test.
 - c. Replacement of any defective items like contactor, relays etc. in the control panel shall be carried out without any extra cost. The required material for replacement of defective items shall be provided by BHEL.
- 1.15.2. **SCOPE OF PRE-COMMISSIONING / COMMISSIONING AND POST COMMISSIONING WORKS:**
- 1.15.2.1. 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 chemical cleaning
 - d. Boiler alkali boil out
 - e. Turbine barring gear
 - f. Steam blowing of piping
 - g. Turbine rolling
 - h. Safety valve floating
 - i. First synchronization
 - j. Heavy oil firing and synchronization
 - k. Coal firing
 - l. Trial Operation/Full Load
- 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 etc.
- 1.15.2.2. The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.
- 1.15.2.3. The pre-commissioning activities of the main power plant will start with energizing of startup power supply systems followed by trial run of various drives prior to light up of boiler. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by them to match with the various milestone activities /commissioning program of the project. All these works need specialized testing engineers, supervisors including electricians in each area to co-ordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark

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separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted for erection work.

- 1.15.2.4. The mobilization of testing team shall be planned in time and shall be undertaken round the clock. 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 will be recovered from contractor.
- 1.15.2.5. Prior to commissioning and after commissioning, protocols have to be made with BHEL / Customer. The formats will 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 Contractors Scope.
- 1.15.2.6. 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 their cost. During commissioning, any improvement rework / rectification / modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.
- 1.15.2.7. All T&P / instruments required for testing including the Generator Circuit Breaker (27 kV) are to be arranged by the contractor.
- 1.15.2.8. 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.
- 1.15.2.9. 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.
- 1.15.2.10. 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.
- 1.15.2.11. 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 their cost.
- 1.15.2.12. 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

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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.

- 1.15.2.13. 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.
- 1.15.2.14. 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 their cost. If any equipment / part are 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.
- 1.15.2.15. Recommissioning of any item listed in BOQ (drives of soot blowers, MOV etc) as per site requirement is to be done by the contractor without any extra claim.
- 1.15.2.16. 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.
- 1.15.2.17. 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 programs made to achieve the schedule agreed with customer.
- 1.15.2.18. 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.
- 1.15.2.19. 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.
- 1.15.2.20. 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.
- 1.15.2.21. It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications

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including for trial operation, even if commissioning of equipment is delayed due to reasons not attributable to the contractor.

1.15.3. **SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY OTHER/ MECHANICAL CONTRACTOR:**

1.15.3.1. 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 and in relevant clauses of this TCC

1.15.3.2. All types of Drives and Generator:

- a. Cable identification, checking and meggering.
- b. IR value of Generator, motor, measurement of winding resistance etc.
- c. Dry out all the motors if required to improve IR value.
- d. Checking direction of rotation of motors and testing and commissioning from local as well as remote.
- e. Checking the bushing and HV test / Tan delta test
- f. Attending to any defects till the handing over of the unit to customer
- g. Erection of peripheral electrical items required for successful commissioning

1.15.4. 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.

1.15.5. 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.

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- 1.15.6. 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.
- 1.15.7. The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.
- 1.15.8. 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.
- 1.15.9. 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.
- 1.15.10. 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.
- 1.15.11. 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.
- 1.15.12. 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.
- 1.15.13. 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

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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.

- 1.15.14. 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.
- 1.15.15. 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.
- 1.15.16. 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.
- 1.15.17. The scope of commissioning shall also cover the commissioning of the equipment / drives erected by the mechanical contractors. (as detailed in the BOQ)
- 1.15.18. 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.
- 1.15.19. 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
- 1.15.20. 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.
- 1.15.21. Minimum requirement of Man Power for testing/checking/commissioning works shall be as follows:

	TRANSFORMER	BUS DUCT	SWITCHGEAR/PANEL	CABLING	C&I
Engineer	1		1	2	2
Supervisor	2	1	4	2	2
Technician	3	2	4	4	4

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The above testing / checking group shall be identified at the Pre-commissioning time. The above commissioning group shall have the knowledge of various systems referred in the tender and possess adequate experience in testing. The above manpower for commissioning is only tentative and if any additional manpower required as per site requirement, the same shall be arranged by the contractor. If the contractor fails to deploy the above Engineer / Supervisor / Technician at appropriate time of commissioning, no payment shall be made against commissioning activities as per terms of payment.

- 1.15.22. 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.
- 1.15.23. 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.
- 1.15.24. 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.
- 1.15.25. T & P / instruments required for testing are to be arranged by the contractor.
- 1.15.26. 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.
- 1.15.27. 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.
- 1.15.28. **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.

- 1.15.28.1. **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.

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- 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.

1.15.28.2. **FLOW METERS / SWITCHES**

Checking the calibration and servicing if required.

- a) Setting the alarm value
- b) Replacement of defective components if any

1.15.28.3. **LIMIT SWITCHES & LEVEL SWITCHES**

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

1.15.28.4. **SOLENOID VALVES**

- a) Checking the healthiness of coil
- b) Checking the operation
- c) Replacement of defective components if required.

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

- a) Checking the healthiness
- b) Replacement of defective element (only for bearing)

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

- a) Checking the calibration
- b) Fixing of bulbs and extending Power supply
- c) Replacing defective components

1.15.28.7. **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.

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- 1.15.29. 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.
- 1.15.30. 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.
- 1.15.31. 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.
- 1.15.32. 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.
- 1.15.33. 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.
- 1.15.34. 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.
- 1.15.35. 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.
- 1.15.36. After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary

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consumables, hand tools and supervision as part commissioning assistance till handing over of sets to customer.

- 1.15.37. 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.
- 1.15.38. 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.
- 1.15.39. 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

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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's etc., erected under the scope of this tender. The painting shall be as required and specified in the painting schedule for power plant equipment, structures, piping etc.
- 1.16.1.2. The scope of painting generally includes painting of all steel items such as supports, racks, frames, Transformers, Bus ducts and GCB besides touch up paints wherever required. Full painting shall be required for specific equipment's as per the scope of erection.
- 1.16.1.3. The scope also includes supply of paints, primers, tools/consumables like brushes, rollers, emery papers, thinner etc., at no additional cost.
- 1.16.1.4. In the case of steel fabricated items, raw steel after fabrication has to be cleaned and subsequent painting to be carried out.
- 1.16.1.5. All the exposed metal parts of the equipment including bus ducts, 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. Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.
- 1.16.1.9. 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.,
- 1.16.1.10. The scope of painting includes application of colour bands, lettering the names of the systems equipment; tag Nos of valves, marking the directions of flow and other data required by BHEL within the quoted rate.

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- 1.16.1.11. 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.
- 1.16.1.12. 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.
- 1.16.1.13. The actual colour to be applied shall be approved by the customer before starting of actual painting work.
- 1.16.1.14. 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.
- 1.16.1.15. 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.
- 1.16.1.16. Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.
- 1.16.1.17. 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

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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 / equipment 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.
- 1.16.3. **FINAL PAINTING**
- 1.16.3.1. 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.
- 1.16.3.2. 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.
- 1.16.3.3. 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.

VOLUME-IA PART-II CHAPTER-1
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 2.13.6	GG clause 2.13.6 is revised as: The rate of interest applicable for the above advances shall be the repo rate prevailing on the date of release of advances plus 4%, and such rate will remain fixed till the total advance amount is recovered.

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S. No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
7	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 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.
8	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: <u>2.7.2 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 in 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.

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S. No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		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. <u>2.7.2.2 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 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

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S. No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		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.
9	GCC Clause 2.7.7	GCC Clause 2.7.7 is revised as: 1. 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, - 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 2. 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.
10	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".
11	GCC Clause 2.19.1	GCC Clause 2.19.1 is revised as:

TECHNICAL CONDITIONS OF CONTRACT (TCC)

S. No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		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.
12	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 (Contractor 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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.

The screenshot displays the SBI Collect website interface. At the top, the 'SB Collect' header is visible. Below it, the 'Payment Progress' bar shows five steps: 'Select Payee' (current), 'Enter Payment Details', 'Verify Payment Details', 'Complete Payment', and 'Print Receipt'. The 'Select Payee' section includes a search bar with 'bhel' entered and a 'Filter by State' dropdown set to '-- Select --'. Below the search results, a table lists two entries:

Name of PSU-Public Sector Undertaking	State
BHEL BAP RANIPET	Tamil Nadu
BHEL PSSR CHENNAI	Tamil Nadu

Below the table, it states 'Showing 1 to 2 of 2 entries (filtered from 113 total entries)'. A 'Back' button is located at the bottom of the 'Select Payee' section. The footer of the page includes '© State Bank of India', 'Privacy Statement', 'Disclosures', and 'Terms of Use'.

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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Following Clauses are modified in the Special Conditions of Contract (SCC)

Sl. No.: 04

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.”

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SI. 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.

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VOLUME-IA PART – II CHAPTER 2 **DATASHEET**

1.2.1.	SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS	
1.2.1.1.	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)
1.2.1.2.	Ferrules	As as mentioned in Chapter-III of Technical Conditions of Contract (Volume-IA Part-I in Book-I)
1.2.1.3.	Tag	
	Material	Aluminium / Fibre / Stainless Steel
	Markings	Engraving / Embossing / Printing
	Size	As required.
1.2.1.4.	Cable lugs	Copper / Aluminium (As Applicable) (crimping type)
1.2.1.5.	CLAMP SPACING:	
	Other Clamps	
	A. Power Cables:	
	<u>Above 35mm OD</u>	
	i) Horizontal runs	Individually clamped at 3000 mm Interval (max)
	ii) Vertical runs	Individually clamped 3000mm intervals (max).
	<u>Upto 35 mm OD</u>	
	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)

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	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.	
1.2.1.6.	Cable termination:	
	Type of Lugs:	
	a. Power Cables	Copper / Aluminium (As applicable) Both crimping type
	b. Control Cables	Copper pin type, copper screw type, Direct termination
	c. Special Cables	Pin type, maxi-termi type.
1.2.1.7.	Anchor fasteners for wall mounted cable trays / JB's	
1.2.1.8.	Insulation tapes	
1.2.1.9.	Paints required for primer & final coating and for protective coating	
1.2.1.10.	Solder wire (Lead) -(60/40)	
1.2.1.11.	Panel sealing compound material (for cable entry from bottom / top of Panel)	
1.2.1.12.	Materials required for cable dressing. (GI / aluminum flats, PVC ties etc).	
1.2.1.13.	PVC wire marker sleeves and Tag plates	
1.2.1.14.	Welding electrodes, filler wires, gases etc	
1.2.1.15.	Metallic clamps for flexible and rigid conduits	
1.2.1.16.	Wastage Allowances	
	HT/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	2%

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	Earth Flats	2%
	Support Installation	1% by weight

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VOLUME-IA PART- II CHAPTER -3

GENERAL TECHNICAL REQUIREMENTS AND GUIDE LINES FOR INSTALLATION, TESTING & COMMISSIONING

1.3.1. Guidelines for Installation of Electrical Items

1.3.1.1.	INSTALLATION, TESTING & COMMISSIONING IN GENERAL: The stages of completion of various works shall be as follows: • Equipment shall be considered to be completely erected when the following activities have been completed. • Moving of all equipment to the respective foundations. • Fixing of anchor bolts or tack welding as required. • Leveling and alignment of equipment. • Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in the job specification. • Filtration and filling of oil as required. • Cable laying, termination with continuity check. • Applying of finishing coat of paint. All the equipment shall be tested at site to know their condition and to prove suitability for required performance. The site tests and acceptance tests to be performed by contractor are detailed below. The contractor shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.
1.3.1.2.	SITE TESTS AND CHECKS:
1.3.1.2.1.	GENERAL: All the equipment shall be tested at site to know their condition and to prove suitability for required performance. The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual has to be conducted at site. In addition to tests on individual equipment some tests / checks are to be conducted / observed from overall system point of view. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated and shall be finalized with consultation of client before charging of the system. The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

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	All checks and tests shall be conducted in the presence of client's representative and test results shall be submitted in six copies to client and one copy to Electrical Inspector. Test results shall be filled in proper proforma. After clearance from Electrical Inspector system/equipment shall be charged in step by step method. Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging are to be brought by the contractor.
1.3.1.2.2.	Trial Run Test: After the successful test of each equipment as per standard test procedure the entire control system shall be put on trial run test on actual site conditions and operation of the system.
1.3.1.2.3.	Acceptance Test: The acceptance test on the system shall be carried out by the supplier as per mutually agreed test procedures to establish satisfactorily functioning of the system as a whole and each equipment as part of the system.
1.3.1.3.	BUS DUCTS – ISOLATED / SEGREGATED PHASE BUS DUCTS
1.3.1.3.1.	HANDLING AND STORAGE: General: Bus duct form the main electrical connections between the Generator and associated generator transformer and tap-off to UAT, VT & SP cubicle and GCB. The ducts are made of aluminium sheet which house the bus bar conductors supported on post insulators. The duct assembled are suitably supported on the structures in the station. The bus enclosure assembled are dispatched with the insulators assembled and the conductor are sent either loose or assembled inside the duct, keeping in view the erection necessities and transport limitations.
1.3.1.3.2.	INSPECTION AT SITE : When the packages are received at site, these must be checked for the following: a. Completeness and correctness of the consignment. (Compare with delivery documents) b. Physical damage if any during transit.
1.3.1.3.3.	HANDLING DURING ERECTION : The bus ducts are in unpacked conditions, therefore, great care is necessary in handling. Ensure that: a. While lifting enclosure assemblies manila ropes are passed round the bus duct enclosure near the support channels. b. All shipping steel clamps are to be tightened and bus bars do not slip out while handling, if the bus bar is assembled in the enclosure.

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	c. While inserting and mounting the bus bar in the enclosure care is d. taken that the bus bar does not hit and damage the insulators. e. Eye bolts are used while lifting the cubicles. f. On completion of clause 2.3.1.3.3, items must be returned to original packing cases unless required for immediate erection. Caution: 1. When inspecting the enclosures assemblies etc. the wooden packings, braces and polythene covers should be replaced, if removed, to prevent damage and ingress of duct and moisture. 2. Aluminium being softer material, great care must be taken in handling enclosures and other aluminum items. 3. If the site conditions make it impossible to return the items to the cases for storage: a. Nothing must be laid direct on the ground. b. All items must be protected against weather and damages.
1.3.1.3.4.	HANDLING OF BUS DUCT: Handling from delivery station to power station stores: 1. Use suitable slings to lift the packages 2. No impact should come on the packings while loading. Do not drop from height. 3. Do not stack bus duct packings one above the other; also avoid stacking of heavier items on bus duct packings
1.3.1.3.5.	DURING UNPACKING, HANDLING AND STORAGE DO's: 1. Check all the packings for any damage during transit. 2. Open the packings carefully. 3. Verify material as per shipping list and report any shortage / damage immediately. 4. Keep material in original packings unless required for erection. 5. Ensure that Manila ropes are used for lifting the bus duct. 6. Check the tightness of shipping steel clamps while lifting bus duct assembly with bus bar in position. 7. Ensure that CTs, LAs, capacitors, N.G. transformer, grounding resistor, fuses, insulators, wall bushings, molded and rubber items and flexibles are stored in well-ventilated area. DON'Ts: 1. Don't destroy any markings.

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	2. Don't drop packings from height. 3. Don't stack heavier items on bus duct packings. 4. Don't keep door of cubicle open during storage. 5. Don't lay down unpacked material directly on the ground. 6. Don't cause damage or scratches by dropping, dragging etc. on fragile items such as CTs, PTs, Insulators, rubber items etc.
1.3.1.3.6.	DURING ERECTION & COMMISSIONING : DOs: 1. Carry out pre-lay survey to verify the position of various equipment to be connected, levels of floors and positions of cutouts. 2. Keep the layout drawing etc. ready for reference. 3. Draw the material from stores as per erection sequence. 4. Ensure alignment and proper matching of various enclosures and bus bars. 5. Ensure proper alignments of epoxy cast CTs and seal-off bushings before final tightening of hardware. 6. Make the bus bar joints as per the instructions. 7. Ensure aluminium welding by qualified welder only. 8. Take care for proper sealing while joining the enclosure. 9. Ensure proper earthing of enclosure and structure as specified. 10. Check wiring as per relevant wiring diagram. 11. Ensure that CT secondaries are shorted and grounded before HV test on bus duct. 12. Ensure that HV test at rated voltage is carried out for IP bus ducts before erection and IR value for all sections of SP and NSPB bus ducts DON'Ts 1. Don't allow accumulation of dirt or foreign material inside the enclosure during erection. 2. Don't overtighten the bolts. 3. Don't hammer the bolts etc. while joining the bus bars if holes are not matching. 4. Don't forget any foreign material inside the enclosure. 5. Don't allow aluminium welding by unqualified welder.

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	6. Don't subject IAS, capacitors, and PTs to HT test as these are pre-tested and test at site is not required. 7. Don't subject NG transformers to over voltage as these are pre-tested. 8. Don't apply rated voltage to full bus duct unless pre commissioning checks are completed. 9. Don't apply any voltage to bus ducts when the ends are connected to equipment like transformer and generator. 10. Don't apply high voltage with surge arrestor and lightning arrestors in circuit.
1.3.1.3.7.	ERECTION INSTRUCTIONS: A. Packing and Shipping: Layout drawing and main bill of material (M.B.O.M) or shipping list should be referred to for identification of various items. All the drawings necessary for assembly and erection are furnished separately. IP Bus ducts are usually dispatched as single phase assemblies generally assembled with bus bars. The bus bars are braced with steel clamps to avoid any damage to insulators and displacement of bus bars during transport. Structures, hardwares, flexibles, and other miscellaneous items are packed separately. B. Marking : Following markings are done with paint on bus duct assemblies and cubicles for identification: - Project name and unit number - Item no of main BOM this is encircled - Phase marking R, Y or B - Work order number - Drawing number and item/variant number - Arrow indicating direction towards transformers end. Direction of arrow shall be decided from lay out. Similarly loose items are also identified by suitable marking on tags.
1.3.1.3.8.	PRE-LAYOUT SURVEY: Before starting the erection work the centre lines of the complete bus duct installation, location of connected equipment such as main transformer, unit auxiliary transformer, VT & SP cubicle, NG Cubicle etc. with respect to generator central line should be established and marked clearly. The various levels of floor, ceiling, terminal position of main transformer, unit auxiliary transformer etc. should also be verified. Any deviations in this regard should be recorded and necessary remedial measures should be taken. In case of any substantial deviation which may affect the erection of bus duct installation, the same should be referred to the design engineer. The remedial measures should be planned in advance, which may consist of levelling by suitable

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	packers chipping of the concrete floor or wall etc. or rectification of the components with the concurrence of engineers.
1.3.1.3.9.	PROVISION OF FOUNDATION BOLTS & EMBEDDED ITEM: In the power station, bus duct is supported on various floors, halls, ceiling, etc. and support structure is suitably attached to the building. For this foundation bolts, embedded items are grouted at number of locations as per foundation drawing.
1.3.1.3.10.	SEQUENCE OF ERECTION: Normally the following sequence of erection is recommended. A. Erection of steel work: First, all the vertical structures are to be installed, leveled and foundation bolts grouted. Next, place all the longitudinal cross channels in position, adjust the level and bolt / weld them. Check up the correctness of levels and positions of various installed structures. For installation of foundation bolts refer foundation details drawing of the project. B. Erection of Enclosures: Before the installation of enclosures in position each assembly of enclosure and conductor complete with insulator supports is to be checked for correctness and cleaned on the working floor. The various enclosures assembled are to be erected as per layout drawing. After placing the assemblies in position the packing braces / steel clamps inside the ducts are to be removed. Some of the bus duct assemblies will be self-supporting only when they are welded to adjacent enclosures, as such some temporary scaffolding is necessary to support these enclosures during erection, leveling and welding. C. Handling of Bus ducts: For handling of bus ducts specified instructions should be followed. D. Sequence of erection-enclosure assemblies: In positioning the various enclosures assemblies, the following sequence is recommended: E. Indoor Portion: (a) Neutral Side Complete the assembly of top chamber/neutral shorting chamber at the working floor as per the drawing. Connect copper flexible on the generator neutral terminals, and fix it with the generator plate. Provide temporary support as necessary. Complete the assembly of bottom chamber (if applicable) along with CTs and wiring as per drawing at the

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working floor and match with the top chamber (if applicable). Now fix the supporting structure. Assemble N.G. Transformer and N.G. Reactor and complete the terminal connections.

Note: Before fixing top chamber / bottom chamber, care should be taken that shunts are welded on line side bus duct as shown in lay out drawing.

(b) Line Side

Assemble copper flexibles and connections with generator line terminals. Match each phase generator enclosure with generator plate and fix to the support structure. Complete the generator terminal bolted connections.

Place P.T cubicle in position match and connect with the respective tap off.

F. Outdoor Portion :

Position the wall frame at the power house wall, place the wall duct and inset the rubber sealing ring over the enclosure. Complete the wall frame assembly.

Place the remaining enclosures on the structure starting from the wall duct and complete the main run to generator transformer. From main run tap-off enclosures are to be connected to unit auxiliary transformers, accommodating current transformers, flexible connection, disconnecting link and rubber bellows.

The alignment and exact locations of ducts may be verified before proceeding for making the assemblies of make-up piece rubber bellows, wall frame and bolted/welded joints of conductor and enclosures.

G. Bus bar Joints:

Bus bar joints may be bolted type or welded type as specified for the installation. For making the bus bar joints, it is essential that specified procedures and precautions are followed.

H. Cleaning of Bus duct

Before putting the split covers, enclosures make up pieces (welded to enclosure) & covers of inspection windows, all the insulator should be cleaned again. The bus duct should also be cleaned and dried up for any moisture/condensates. Thoroughly check the interior of every enclosures and ensure that these are free from any foreign matter.

I. Inspection of windows, covers, etc.

Finally, the split covers, inspection windows and make-up piece may be assembled. The assembly of split cover, inspection windows and make-up pieces should be done as per recommended procedures and if should be ensured that proper sealing is achieved.

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1.3.1.3.11.	BUS BAR BOLTED JOINTS: A. Aluminium to Aluminium Joints (Un plated): 1. Wipe the contact surfaces with dry clean cloth to remove any dirt, dust and moisture and smear these with recommended jointing compound. 2. Clean the surfaces under the compound by breading with dry coarse emery cloth or stainless steel wire brush. Wipe the surfaces with a clean dry cloth and immediately make a light application of jointing compound. 3. Close up the joints and wipe off excess compound. B. Aluminium to Copper Joints : 1. Cleaning of Aluminium surface (Unplated) 2. Follow Instructions given under clause 2.5.4.0 (A) above and apply jointing compound. 3. Cleaning of copper surfaces (unplated) 4. Clean the copper contact surface with emery cloth and wipe the surface with clean dry cloth. 5. Cleaning of copper aluminium surfaces (unplated) 6. Clean the contact surface with dry cloth to remove dirt, dust and moisture. Apply a light coating of jointing compound. C. Aluminium to Copper Joints using bimetallic strip: 1. For cleaning of aluminium and copper surfaces follow instructions given under 2.5.4.0 (A&B) above. Apply jointing compound to aluminium and copper surfaces. The contact faces of bimetallic strip should also be cleaned as per the above practice and jointing compound applied. Bimetallic strip will be provided by BHEL. Note: Bimetallic strip is inserted between the copper and aluminium surfaces. Care should be taken that copper faces copper surface and aluminium faces aluminium surface. D. Cleaning of copper surfaces (plated): 1. Clean the contact surface with dry cloth to remove dirt, dust and moisture. Note: Wire, brush, emery cloth or jointing compound containing metallic particles or other abrasives should not be used on plated surfaces.
1.3.1.3.12.	CONTACT PRESSURE: To obtain correct tightening pressure on contact surfaces following torques are recommended for various bolt sizes.

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	<table><tr><th>Bolt Size</th><th>Recommended Torque</th><th>Torque Spanner Capacity</th></tr><tr><td>M10</td><td>0.85 to 1.3 NM (20-30 Ft-lb)</td><td>0.85 to 1.3 NM (20-30 Ft-lb)</td></tr><tr><td>M12</td><td>1.3 NM to 1.7 NM (30-40 Ft-lb)</td><td>0.85 to 4.3 NM (20-100 Ft-lb)</td></tr><tr><td>M16</td><td>1.7 to 2.1 NM (40-50 Ft-lb)</td><td>0.85 to 4.3 NM (20-100 Ft-lb)</td></tr><tr><td>M20</td><td>2.1 to 2.5 NM (50-60 Ft-lb)</td><td>0.85 to 4.3 NM (20-100 Ft-lb)</td></tr></table>	Bolt Size	Recommended Torque	Torque Spanner Capacity	M10	0.85 to 1.3 NM (20-30 Ft-lb)	0.85 to 1.3 NM (20-30 Ft-lb)	M12	1.3 NM to 1.7 NM (30-40 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)	M16	1.7 to 2.1 NM (40-50 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)	M20	2.1 to 2.5 NM (50-60 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)	
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M20	2.1 to 2.5 NM (50-60 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)															
	Alternatively tighten the nut till belleville washer becomes flat. Then unscrew the nut by about 1/8th turn.																
1.3.1.3.13.	RECOMMENDATION FOR WELDED JOINTS A. Circumferential weld circular section : A FULLY penetrated; fully fused welded with a 10%T (4mm max) reinforcement is required. Welding conditions M.I.G. Process <table><tr><td>Filler wire</td><td>1.6mm dia (NG 21 with 5% silicon)</td></tr><tr><td>Angle</td><td>10° to 15° Forehand</td></tr><tr><td>Cleaning</td><td>Decrease and scratch brush</td></tr><tr><td>Setting</td><td>250A to 320A, 28 to 30 Volts (Dependent on thickness)</td></tr><tr><td>Process</td><td>4 off 25mm long equi spaced tack welds</td></tr><tr><td>Gas Supply</td><td>50 Cu. ft/hr argon – 10-12 Lits/Min.Argon</td></tr><tr><td>Shield</td><td>5/8" dia</td></tr><tr><td>Purity</td><td>99.98%</td></tr></table>	Filler wire	1.6mm dia (NG 21 with 5% silicon)	Angle	10° to 15° Forehand	Cleaning	Decrease and scratch brush	Setting	250A to 320A, 28 to 30 Volts (Dependent on thickness)	Process	4 off 25mm long equi spaced tack welds	Gas Supply	50 Cu. ft/hr argon – 10-12 Lits/Min.Argon	Shield	5/8" dia	Purity	99.98%
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	B. Tubular Conductors: Tubular Conductors are used in tee-off connections Welding conditions M.I.G. Process <table><tr><td>Filler Wire</td><td>1.6 mm dia (NG 21 with 5% silicon)</td></tr><tr><td>Angle</td><td>10° to 15° Forehand</td></tr><tr><td>Cleaning</td><td>Degrease and scratch brush</td></tr><tr><td>Setting</td><td>215A to 275A, 22 to 2 Volts</td></tr><tr><td>Gas Supply</td><td>50 Cu. ft/hr argon</td></tr><tr><td>Shield</td><td>5/8" dia</td></tr><tr><td>Purity</td><td>99.98%</td></tr></table>	Filler Wire	1.6 mm dia (NG 21 with 5% silicon)	Angle	10° to 15° Forehand	Cleaning	Degrease and scratch brush	Setting	215A to 275A, 22 to 2 Volts	Gas Supply	50 Cu. ft/hr argon	Shield	5/8" dia	Purity	99.98%		
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	C. Enclosures Fillet weld for make up pieces/shunts. Tack weld at four places. Welding conditions M.I.G. Process : <table><tr><td>Filler Wire</td><td>1.6 mm dia (NG 21 with 5% silicon)</td></tr></table>	Filler Wire	1.6 mm dia (NG 21 with 5% silicon)														
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	Angle	10° to 15° Forehand
	Cleaning	Degrease and scratch brush
	Setting	200A to 300A, 25 to 30 Volts (Dependent on thickness)
	Gas Supply	50 Cu. ft/hr argon
	Shield	5/8" dia
	Purity	99.98%
	D. Drain valve and welding: Owing to the dissimilar thickness used for this fillet weld, the arc must be directed into the pad only and not allowed to melt away and enclosure.	
1.3.1.3.14.	WELDED BUS ENCLOSURE JOINTS: Bridge the gap between the bus enclosure by means of make up pieces and clean the area by paint removed which is to be welded. Tack weld the make up pieces before final filled weld all around.	
1.3.1.3.15.	WELDED JOINTS OF SHUNTS: Various locations of shunts to be welded to the enclosures are shown in layout drawing.	
1.3.1.3.16.	DRAIN VALVE WELDING (IF APPLICABLE): Mark the location as per lay out and drill 10mm dia hole at the bottom most point of enclosure. Tack weld the drain valve pad to enclosure ensuring proper alignment of paid hole with enclosure hole. Weld continuously as per jointing recommendations. Clean with wire brush and point for final finish.	
1.3.1.3.17.	FIXING OF NEOPRENE SEAL : Enclosures are fitted with access covers. Each cover is fitted with four pieces of neoprene seal and held in position by bolted clamps. (Note: Only one cover should be removed from enclosure at any time to minimize the air flow into the enclosure).	
1.3.1.3.18.	EARTHING OF ISOLATED / SEGREGATED PHASE BUS DUCT AND CUBICLES A. General One end of the electrical continuous enclosure should be earthed to station earth at the shunt location where all the three enclosures are shorted. Location of earth points are shown in the layout drawing. For this purpose, two drillings are to be done on these shunt to suit at site and two	

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	separate earth strap are to be connected to the station earth thus ensuring double earthing. In some assemblies (such as transformer hood etc) due to short length of enclosures shunts are not provided. In such cases, each phase enclosure should be separately earthed. One point of the earth phase split cover, rubber bellow clamping strap should be electrically connected to enclosures and in turn enclosures should be earthed. B. Cubicle earthing : Each cubicle is provided with two number of earthing terminals. These terminals are generally located on side face of the cubicle. Both the terminals are to be connected independently to the station earth by suitable connectors. For earthing the top and bottom C.T. chambers, station earth can be connected to each chambers of two locations for double earthing.
1.3.1.3.19.	SITE TESTS ON ISOLATED /SEGREGATED PHASE BUS DUCT A. Physical Checks: Design survey which include dimensional checking of electrical clearances and cleanliness of the installation. B. Cleanliness: The inside of all enclosures, outside of conductors and insulators should be free from dirt, all, grease, swaft and any deposits, special attention should be paid to the insulators and seal off bushings and oil moisture is to be removed and surfaces polished with a dry soft clutch. All panels/inspection windows cover are to be replaced after cleaning operation. C. Power Frequency High Voltage Test Preparation : 1. Following equipment must be disconnected from bus bars removing the bolted link and grounded suitably prior to conducting this test: a. Generator terminals b. Unit auxiliary transformer terminals c. Generator transformer terminals d. Neutral grounding transformer HV terminal e. Lightning arresters f. Capacitors g. Potential transformer.

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	kept at ground potential. Remaining two phase conductors and their enclosure shall be properly as in consistent with its value being indicated by the measuring instrument. The full test voltage shall be then maintained for specified duration. Each bus including tap-off must withstand the above test voltage																										
1.3.1.3.20.	SITE TEST RECORDS ON ISOLATED PHASE / SEGREGATED PHASE BUS DUCTS : Test conducted on date..... Site Power Frequency high voltage test : Instrument <table><tr><th rowspan="2">Phase</th><th colspan="2">Meggar Reading after</th><th rowspan="2">HV applied& duration</th><th rowspan="2">Leakage current A.C./ D.C.</th><th rowspan="2">Remarks</th></tr><tr><th>before HV test</th><th>before HV test</th></tr><tr><td>R</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Y</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>B</td><td></td><td></td><td></td><td></td><td></td></tr></table>	Phase	Meggar Reading after		HV applied& duration	Leakage current A.C./ D.C.	Remarks	before HV test	before HV test	R						Y						B					
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B																											
1.3.1.4.	TRANSFORMER																										
1.3.1.4.1.	INSTALLATION: To ensure that a Transformer will function satisfactorily, it is important that handling, lifting, storing and assembling are carried out with great care and cleanliness by experienced personnel who know the various working operations very well.																										
1.3.1.4.2.	INSPECTION: In connection with receiving and unloading at site, and at the final storing place before assembling, the transformers shall be inspected carefully. External visible damages as dents, paint damage etc. may imply that the transformer has been subjected to careless handling during transport and/or re-loading, and a careful investigation is therefore justified. After the arrival of the material at receiving points, before unloading, the condition of packing and of the visible parts should be checked and possible traces of leaks verified (condenser bushing). If necessary, appropriate statements and claims should be made. Drums containing oil which have separately dispatched should be examined carefully for leaks or any sign of tampering. All dispatched drums are filled up to their capacity and any shortage should be reported. Check immediately the gas pressure at the arrival. A positive indicates that the tank and the transformer components respectively are tight, and that the active part including the insulation materials is dry.																										

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	If there is no positive gas-pressure, transformer should be immediately filled with dry Nitrogen gas at a pressure of 0.17 kg/cm² (2.5 psi) without loss of time. Otherwise, it should be checked if the core isolation is satisfactory and that accessories packed separately have not been damaged during transportation.
1.3.1.4.3.	UNLOADING: Whenever rollers/trolleys are supplied with transformer, movement of transformer at site is carried out by mounting these rollers / trolleys. Alternatively for movement of transformer from loading bay to actual site of the equipment, skidding on greased rails etc can also be resorted to.
1.3.1.4.4.	STORING: Dismantled equipment and components are packed to the protected against normal handling and transport stresses. The instructions for lifting given on the packages, must be complied with to avoid damages. Goods stored outdoors must not be placed directly on the ground, and should be covered carefully with tarpaulin or similar materials. Oil drum should be stored in horizontal (lying) position with both the bungs also in horizontal position.
1.3.1.4.5.	LIFTING: Lifting devices on the transformer tank are dimensioned of lifting of the complete transformer filled with oil. The positioning of the lifting devices, permissible lifting angles, minimum height to crane hook and transformer weight, appear from the OGA drawings. Check at lifting of complete transformer that the lifting wires/ropes are not in contact with bushing or other components on the cover. For lifting with hydraulic jacks, the transformer is provided with jacking pads dimensioned for lifting of complete transformer filled with oil. The position of the pads appear on the OGA drawings.
1.3.1.4.6.	CHECK POINTS BEFORE STARTING AND DURING ERECTION: a. Check points before starting erection. 1. Conditions of leads 2. Bracing, clamping of leads 3. Connections 4. Tap changer checks 5. General conditions of insulation 6. Core check that it has not moved in transit. 7. Core-ground; this is checked with the megger after removing earth connection

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	8. CTs, including the secondary leads and their passage through metal parts 9. Check that shipping frame for bushings have been removed. 10. Check that coil position has not moved in transit 11. Check for dirt, metal swarf, moisture 12. Check that the bushing leads set without being too close to ground or other points of different potential. b. Check-points during erection: By means of the part list and the transformer / reactor OGA, the assembling of a fully completed transformer is carried out according to the following instructions. The following precautions are to be taken: 1. Fire-fighting equipment shall be available at the oil-treatment equipment as well as at work on and adjacent to the transformer. 2. Welding work on or adjacent to the transformer shall be avoided, but if this is not possible, the work shall be supervised by fire-protection personnel. 3. Smoking on or near the transformer shall not be allowed. 4. Transformer tank, control cabinet etc, as well as assembling and oil-treatment equipment shall be connected with the permanent earthing system of the station 5. Check that there is no overpressure in the transformer when blanking plates or connection lids are to be opened. 6. All loose objects, tools, screws, nuts etc. shall be removed from the transformer cover before opening the connection and blanking lids. 7. All loose objects (tools, pencils, spectacles etc.) shall be removed from the boiler- suit pockets etc. before starting the work through man-holes. 8. Tools to be used inside the transformer e.g. for tightening of screws-joint-shall be fastened to the wrist or another fixed point by means of cotton tape or string. 9. Tools with loose sleeves and tools with catches must not be used at work inside the transformer. 10. Greatest possible cleanliness shall be observed at work inside the transformer, and at handling of part to be mounted inside the transformer. 11. Fibrous cleaning materials should not be used as it can deteriorate oil when mixed with it. 12. All components dispatched separately should be cleaned inside and outside before being fitted.

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	13. A Transformer is best protected for damp hazard by circulating warm, dry, de-aerated oil through it until its temperature is 5° C to 10° C above ambient. This should be done before allowing external access to the interior of the tank. The warm oil should be circulated all the time the transformer is open to atmosphere. 14. Oil pump & all joints in the oil pipe work should be air tight to avoid entrance of air through leakage joints. 15. The active part (core and winding) should be exposed to the surrounding air as short time as possible. Open therefore only one blanking plate or connection lid at a time for remounting of bushing, valves etc. 16. Objects which despite all precaution are dropped inside transformer / reactor, must absolutely be brought up from the equipment. 17. Check that the oxygen content inside the transformer tank is minimum 20% if a person is to enter the tank.
1.3.1.4.7.	ASSEMBLY: Assembly of wheels Bushing Valves, cooling device, Oil conservator, Pilot Flanges, Blanking plates and accessories like cooling fans, pumps, OLTC and components for supervision and control oil level indicator, flow indicators, gauges, Buchholz relay, PRV, thermometers etc. are assembled according to leaflet / description valid for the components.
1.3.1.4.8.	OIL FILLING: The following procedure is recommended. 1. Close and blank the valve to isolate the conservator from main tank. Fill the oil in transformer under vacuum up to Buchholz level as per instructions given elsewhere. 2. After filling the oil in transformer and breaking the vacuum, oil can be filled in the conservator either through reactor or by drain valve. 3. Remove the inspection cover (ii) provided on the side of the conservator and check the air cell assuring that it is inflated. The air must remain in fully inflated condition during oil filling operation. If the air cell is found deflated fit the inspection cover and inflate the air cell with dry air / nitrogen gas to 0.035 kg/sq.cm max. A gauge may be put by removing plug. After filling close these connections. 4. Remove air release plugs provided on top of the conservator. 5. Slowly pump the oil through main reactor / drain valve. Temporarily stop filling operation when oil starts coming from opening after ensuring that no air bubbles come out through these air release holes. Fit the two air release plugs.

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	6. Continue oil filling till oil start coming from air release plug stop oil after ensuring that no air bubbles come out. Fit the plug. 7. Now release the air pressure held inside the air cell from point and continue oil filling until magnetic oil gauge indicates 35 deg. C level. 8. Remove oil pump and connect air cell to breather from point. Also remove pressure gauge and put plug. 9. The system is now properly filled. Air release plugs are fitted in normal operation.								
1.3.1.4.9.	EQUIPMENT FOR OIL-FILLING UNDER VACUUM 1. High-vacuum 2 storage oil filtration plant provided with thermostat-controlled oil heaters and vacuum-proof hoses with dependent vacuum pumping system for tank evacuation. Capacity: 10KL / Hour 2. Oil-storage tanks provided with silica-gel breathers and inlet / outlet valves for oil circulation. Recommended capacity 40KL 3. Vacuum gauges provided in filtration plant. 4. Equipment for measurement of electric strength (BDV) of oil - 100 kv set. 5. Equipment for moisture content of oil. 6. Equipment for measurement of Resistivity and Tan delta at 90 C. 7. Transparent vacuum-proof tubes for checking of oil-level during oil filling. 8. Valves, fitting, gaskets etc. 9. Dry nitrogen cylinders.								
1.3.1.4.10.	COMMISSIONING: Testing after Assembly of the Transformer After the transformer has been assembled at site, it shall be tested in order to check that it has not been damaged during transport and assembly to such an extent that its future operation will be at risk. Regarding the performance of the test, refer to the testing method as per standards. The results of the test shall be documented.								
1.3.1.4.11.	COMMISSIONING CHECKS A. CHECK LIST <table border="1"> <thead> <tr> <th>Sl.No.</th><th>Description</th></tr> </thead> <tbody> <tr> <td>01</td><td>Breather Silica gel (Blue when dry)</td></tr> <tr> <td>02</td><td>Oil in the Breather housing cup</td></tr> <tr> <td>03</td><td>All valves for their correct opening and closing sequence</td></tr> </tbody> </table>	Sl.No.	Description	01	Breather Silica gel (Blue when dry)	02	Oil in the Breather housing cup	03	All valves for their correct opening and closing sequence
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	04	Oil level in conservator tank
	05	Oil in cooling system
	06	Oil level in bushings
	07	Release air, wherever necessary
	08	Cooling accessories (Pump motors, Fan motors etc.) for direction and O/L setting
	09	Buchholz, oil level indicator, pressure gauges, thermometer, Temp. indicators etc
	10	Neutral Earthing
	11	Earth Resistance of Electrodes
	12	Earthing of bushing test tap
	13	Check oil leakage for 24 hrs
	14	Check Auxiliary Circuit Voltage (415 V)
	15	Calibration of OTI/WTI with hot oil
	16	Check Working of WTI/RTD repeaters at control room
	17	IR of core to earth
	18	Di-Electric strength of oil PPM & Chemical analysis specific gravity test
	19	IR tests on windings to earth and between winding
	20	Phase sequence test & Vector group check
	21	Continuity test
	22	No load voltage ratio on all tap position
	23	Winding resistance in all taps
	24	Tap changing at 415 V, 3 phase, 50 Hz supply in all three phases
	25	TAN-Delta test if quality check list calls for
	26	Dew point check for N2 Gas at the time of oil filling

B. INSULATION RESISTANCE TEST

Sl.No	Description	Date	Time in Hrs	Megger (Refer Note (3))	IR Value	Temp	Remarks
1	Control wiring						
2.	Tap Changer						
a)	Motor						
b)	Control						
3.	Cooling system						
a)	Motor Fan						
b)	Motor pump						
c)	Control Wiring						
4.	Main Winding						
a)	HV/E+LV						

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b)	LV/E+HV						
c)	HV/IV						
d)	IV/LV						
e)	HV/LV						

Note :-

1. While checking these values no external, lightning arrestors etc should be in circuit.
2. Special care should always be taken while meggering the transformer winding to ensure that there is no leakage in the leads.
3. Megger voltage to be decided based on the voltage rating of equipment under test.

C. OIL CHARACTERISTICS.

Take necessary precaution (regarding rinsing the bottle, cleaning hand, air bubble etc) while withdrawing the samples, Each sample should be free of air bubbles and should not be tested when it is hot. The sample should satisfy IS:1866.

1. Tank Top Sample Bottom Sample
2. Cooling system Top Sample Bottom Sample
3. OLTC Divertor (each phase)

D. TESTS ON CT:

1. Ratio
2. Polarity
3. Magnetizing current
4. IR Value

E. POTENTIAL TRANSFORMER TESTS:

1. IR test of secondary winding by LV megger between winding and winding to earth
2. IR test of primary winding by HV megger between windings
3. Checking of voltage ratio
4. Verification of terminal markings and polarity
5. Checking of oil level if applicable
6. Checking of continuity and IR values for cables from PT to M
7. Checking tightness of earthing connection.
8. Checking of insulator for cracks
9. Checking output on charging of the system with connected meter

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	F. ON LOAD TAP CHANGER <table><tr><th>Sl.No</th><th>Description</th><th>Date</th><th>Observation</th><th>Remarks</th></tr><tr><td>1</td><td>Visual Inspection of equipment.</td><td></td><td></td><td></td></tr><tr><td>2</td><td>Hand operation on II taps.</td><td></td><td></td><td></td></tr><tr><td>3</td><td>Complete wiring of the circuits</td><td></td><td></td><td></td></tr><tr><td>4</td><td>Limit Switch</td><td></td><td></td><td></td></tr><tr><td>5</td><td>Over running device</td><td></td><td></td><td></td></tr><tr><td>6</td><td>Remote Panel Wiring.</td><td></td><td></td><td></td></tr><tr><td>7</td><td>Overload Device of Driving Motor.</td><td></td><td></td><td></td></tr><tr><td>8</td><td>Local Operation (Electrical)</td><td></td><td></td><td></td></tr><tr><td>9</td><td>Remote Operation (Electrical)</td><td></td><td></td><td></td></tr><tr><td>10</td><td>Tap Position Indicator.</td><td></td><td></td><td></td></tr><tr><td>11</td><td>Step by step contractor</td><td></td><td></td><td></td></tr><tr><td>12</td><td>Out of Step Relay.</td><td></td><td></td><td></td></tr></table> Note: 1. While operating the mechanism on Electrical Control, check once again limit switches, step by step contractor, over running device etc. for their actual operation and prove that they are functioning properly. 2. For More details Please refer Respective Manuals.	Sl.No	Description	Date	Observation	Remarks	1	Visual Inspection of equipment.				2	Hand operation on II taps.				3	Complete wiring of the circuits				4	Limit Switch				5	Over running device				6	Remote Panel Wiring.				7	Overload Device of Driving Motor.				8	Local Operation (Electrical)				9	Remote Operation (Electrical)				10	Tap Position Indicator.				11	Step by step contractor				12	Out of Step Relay.			
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1.3.1.5.	GUIDELINES FOR ERECTION OF HT SWITCHGEAR PANELS:																																																																	
1.3.1.5.1.	Erection 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 frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing works are to be completed. All the panels/board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled craftsmen. All the boards will be delivered in sections. Necessary interconnection of bus bar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.																																																																	
1.3.1.5.2.	THE FOLLOWING POINTS SHALL BE CHECKED UP DURING ERECTION 1. Layout of foundation channels. 2. Floor level covered by the panel with respect to main floor level.																																																																	

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	3. Location and serial no. of panels. 4. Positioning of panels. 5. Verticality of switchgear panels within the limit specified. 6. Freeness of Breaker Truck and modules in housing and its manual operation. 7. Earthing of panels and breaker truck to station earth. 8. Lugs for termination of HT and LT cables. 9. Mounting and fixing arrangements of Bus bars. 10. Tightening of Bus bar jointing bolts as specified. 11. Clearance between : i. Phase to Phase ii. Phase to earth 12. Minimum clearance for: i. Breaker, Truck and modules withdrawal ii. Distance required for maintenance work 13. Check the operation of: i. Remote control ii. Various required - closing / tripping / alarm / indications / interlocks 14. Installation position of insts and relays Operation of relays and meters by secondary injection. 15. AC/DC supplies for panel final relay settings as per customer requirements. 16. Tightness of terminal connections for HT & LT connections. 17. Opening operation of breaker, manually and electrically. 18. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.
1.3.1.5.3.	HT SWITCHGEAR TESTS 1. IR test 2. HV one minute P.F. test checking of oil level 3. Measurement of contact resistance for HT breakers 4. Test to prove inter changeability of similar parts (including breaker module) 5. Testing of relays as per supplier's commissioning manual 6. Testing and calibration of all meters. 7. Operation of all relays by secondary injection method 8. Testing of CT polarities and CT ratio by primary injection test.

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	9. Measurement of knee point voltage and secondary resistance for CTs used for differential protection. 10. IR and voltage ratio test for PTs 11. Functional test of all circuit components for each panel / feeder. 12. Test to prove closing/tripping operation at minimum and maximum specified voltage in test and service position. 13. Check for draw out test and service position of breakers for all feeders. 14. Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker. 15. HV test on vacuum interrupters (for VCBs) 16. Check for pressure of SF6 gas and air (for SF6).
1.3.1.6.	LT SWITCHGEAR PANELS
1.3.1.6.1.	ERECTION 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 frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing works are to be completed. 2. All the panels/board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled craftsmen 3. All the boards will be delivered in sections. Necessary interconnection of bus bar, bolting of panels, left out panel / inter panel wiring, etc. will have to be done after assembling the panel.
1.3.1.6.2.	CHECKS DURING ERECTION 1. Layout of foundation channels. 2. Floor level covered by the panel with respect to main floor level. 3. Location and serial no. of panels. 4. Positioning of panels. 5. Verticality of switchgear panels within the limit specified. 6. Freeness of Breaker Truck and modules in housing and its manual operation. 7. Earthing of panels and breaker truck to station earth. 8. Lugs for termination of LT cables. 9. Mounting and fixing arrangements of Bus bars. 10. Tightening of Bus bar jointing bolts as specified. 11. Clearance between :

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	i. Phase to Phase ii. Phase to earth 12. Minimum clearance for : i. Breaker, Truck and modules withdrawal ii. Distance required for maintenance work 13. Check the operation of: i. Remote control ii. Various required - closing / tripping / alarm / indications / interlocks 14. Installation position of instruments and relays operation of relays and meters by secondary injection. 15. AC/DC supplies for panel final relay settings as per customer requirements. 16. Tightness of terminal connections for HT & LT connections. 17. Opening operation of breaker, manually and electrically. 18. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.
1.3.1.6.3.	LT SWITCHGEAR TESTS 1. IR test 2. Measurement of contact resistance for LT breakers 3. Test to prove inter changeability of similar parts (including breaker module 4. Testing of relays as per supplier's commissioning manual. 5. Testing and calibration of all meters. 6. Operation of all relays by secondary injection method. 7. Testing of CT polarities and CT ratio by primary injection test. 8. Measurement of kneepoint voltage and secondary resistance for CTs used for differential protection 9. IR and voltage ratio test for PTs 10. Functional test of all circuit components for each panel / feeder 11. Test to prove closing / tripping operation at minimum and maximum specified voltage in test and service position 12. Check for drawout test and service position of breakers for all feeders 13. Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker.
1.3.1.6.4.	GUIDELINES FOR CABLE LAYING: 1. In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed

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	in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be. 2. In case of multi-core cables of diameter up to 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. 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. 4. GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends. GI conduits shall be provided by BHEL. 5. In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy duty PVC pipes shall be provided. PVC pipes shall be provided by BHEL. 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. 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. 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 2000 mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type. 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. 10. Cable trays shall be supported on ISA 50x50x6mm MS/GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas. 11. Wherever direct heat radiation exists, heat isolating barriers (subject to customers approval), for cabling system shall be adopted.

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	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. 13. If required, a few numbers of cables in exceptional areas may be directly buried into the earth. 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. 15. At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled. 16. In corrosive atmosphere, PVC conduits shall be used for cables. 17. Single core cables, when pulled individually shall be taken through PVC pipes only. 18. Laying and installation of power, control and special cables shall generally conform to IS : 1255 19. The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation). 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. 21. Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer. 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. 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 25m spacing for straight runs or as specified by Engineer for easy identification of cable. 24. When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.

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	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. Trefoil clamps shall be provided by BHEL 26. Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacing not less than one cable diameter of bigger diameter cable. 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. 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. 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 (trays) D. Special control cables including screened control cables to be laid in the bottom most tray(s). 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. 31. When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses 29 & 30 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 100 mm between them. B. LT power cables are mixed up with control cable with clear minimum gap of 150 mm between them. C. LT power cables are mixed up with HT power cables with clear minimum gap of 200 mm between them. D. LT power cables are mixed up with special control cables with clear minimum gap of 200 mm between them.

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	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. 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 galvanized. 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 6 mm thickness. 35. To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used. 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. 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. 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. 39. Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer. 40. SUPPORT SPACINGS & CLAMPINGS Support spacing and clamping suitably provided and as required 41. LAYING OF CABLES DIRECTLY BURIED IN GROUND Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255. 42. SUPPORT SPACINGS & CLAMPINGS

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Trefoil Clamps:	
i. Horizontal run spacing	1000 mm (max)
ii. Vertical run spacing	1000 mm (max)
iii Axial spacing between adjacent trefoils	Double the diameter of larger cable or 150 mm Whichever is less

43. OTHER CLAMPS

POWER CABLES		
Above 35 mm OD	Horizontal runs	Individually clamped at 3000 mm Interval (max)
	Vertical runs	Individually clamped 3000mm intervals (max)
Upto 35 mm OD	Horizontal runs	Collectively clamped at 3000 mm intervals (max)
	Vertical runs	Collectively clamped at 2000 mm interval (max)
CONTROL CABLES		
For all sizes	Horizontal runs	Collectively clamped at 3000 mm interval (max)
	Vertical runs	Collectively clamped at 3000 mm interval (max)
SPACING FOR CABLES SUPPORTED ALONG STRUCTURES/CEILINGS		
Clamping/ Spacing	In Horizontal runs	750 mm (max)
	In Vertical runs	750 mm (max)
Spacing between cables		30 mm (min)
Note: 1. Supports shall also be provided at each bend. 2. For any change in above spacing, prior approval of Engineer will be taken		

44. CABLE TERMINATION AND JOINTING

- a. 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 drilling holes. Cutting shall not be allowed.
- b. 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.

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	c. All cable entries in the equipment shall be sealed after glanding the cables. d. Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core/conductor. e. 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. f. 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. g. Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs. h. 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. i. 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. The straight through jointing kits for LT power/control cables as required shall be arranged by the contractor at their cost. The make shall subject to approval of BHEL's Engineer. j. 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. 45. TESTING OF CABLES: i. The contractor shall submit to the Engineer a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist. ii. Testing and electrical measurement of cable installations shall conform to IS : 1255 iii. Prior to installation, cables shall be tested for : a. Continuity of conductors b. Insulation resistance between conductors & earth

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	c. Insulation resistance between conductors. iv. After installation cables shall be tested for : a. Insulation resistance between conductors & iron b. Insulation resistance between conductors & earth c. Conductor resistance d. Capacitance between conductors & earth (for cables above 7C.1.3KV grade) e. DC high voltage test (for LT power cables of higher sizes interconnecting PCCs & MCC) f. Absence of cross phasing g. Firmness of terminations
1.3.1.7.	ERECTION AND COMMISSIONING OF MISCELLANEOUS ITEMS All the miscellaneous items shall be Erected, Tested and Commissioned as per the instruction manuals (or) as instructed by the Engineer.
1.3.1.8.	TESTS FOR THE EQUIPMENT ERECTED BY OTHER/MECHANICAL CONTRACTOR The tests to be carried out on the equipment at which are normally being erected by Mechanical contractor.
1.3.1.8.1.	GENERATOR Generator set with all auxiliaries and controls shall be assembled and tested to verify compliance with the guaranteed technical particulars and for satisfactory performance. Relevant standards shall be followed as guideline for testing. All the tests shall be witnessed by customer or its representative. The commissioning tests shall be carried out at site under normal service conditions. Following tests shall be carried out on the generators: 1. Insulation resistance test and determination of polarization index value of: a. Generator b. Exciter c. Resistance temperature detectors 2. Dielectric test 3. No load characteristics 4. Short circuit characteristics 5. Temperature rise at rated voltage, current, power factor and frequency. 6. Calculation of efficiency 7. Phase sequence / voltage balance / current balance checks. 8. Instantaneous short circuit test (Optional).

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	9. Response of voltage and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively. 10. Measurement of DC resistance of winding 11. Inter turn insulation test of stator winding with induced voltage 130% of rated value for 5 minutes (if applicable). 12. Measurement of shaft voltage. 13. Measurement of Stator and bearing temp. during load run. 14. Tan Delta test for generator bushing (If required).
1.3.1.8.2.	AC MOTORS 1. IR test of stator and rotor windings. 2. Heating of both windings up to the permissible temp. 3. Checking/testing of associated switchboard, cables, relays / meter interlockings as mentioned in relevant chapters are completed. 4. Tightness of cable connection. 5. Winding resistance measurement of stator and rotor. 6. Checking continuity of winding. 7. Checking tightness of earth connections. 8. Checking space heaters and carryout heating of winding (if required) 9. Checking direction of rotation in decoupled condition during kick start 10. Measurement of no load current for all phases 11. Measurement of temperature of body during no load and load conditions. 12. Check for tripping of motor from local/remote switches and from. 13. Checking of vibration (if required). 14. Checking of noise level (if required) 15. Measurement of stator and bearing temperatures during load running (if applicable) for every half an hour interval till saturation comes 16. Checking operation of speed switch (if there) 17. Checking of polarisation index of stator winding, R10/R1 by motorised megger (The value should not be less than 2.0) R60/10 absorption coefficient shall not be less than 1.5 18. Dielectric test
1.3.1.8.3.	DC MOTORS 1. IR measurement and heating the winding as per heating curve.

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	2. Check for earth connection 3. Winding resistance for field and armature. 4. Check running of drive at minimum and maximum specified. 5. Check auto start of drive on failure of AC supply (if applicable) 6. Check operation of overload relay. 7. Measure load currents and no load currents (if possible) 8. Check direction of rotation. 9. Check continuity of winding. 10. Measurement of RPM.
1.3.1.8.4.	ESP TRANSFORMERS Dry out of transformers (Oil filtration) till achieving desired BDV, IR Value, Calibration of oil temperature gauges, Checking of breather gauge, Relays, HV Test etc. i.e. scope of commissioning of ESP Transformer shall be in line with transformers erected by the contractor. Replacing defective components like Temperature gauges, breather glass etc. Attending to any defects till handing over of the unit to customer by BHEL. Any oil top up of required after first commissioning of the transformer shall be in the scope of the bidder up to handing over of the package.
1.3.1.8.5.	PANELS: The panels shall be mostly skid mounted and the skid will be erected by mechanical contractor. The scope of commissioning of Panels covers checking of internal wiring and associated loop cables from panels to field instruments, Push Buttons, JBs, drives, replacing defective components/instruments/electronic cards etc. If any loop cables (power or control) are to be laid or replaced, the same shall be carried out at unit rates available in the BOQ. For commissioning of associated drives, if any, the unit rate will be as per BOQ and this will not be part of panel commissioning.
1.3.1.8.6.	NOTE: 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.
1.3.1.8.7.	CODES AND STANDARDS

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	1. All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and / or supplemented by this specification. 2. Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid. The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to dates, relevant IS codes of Practice and Indian Electricity Act. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding. A list of applicable standards is given below for reference. IS 3043 Code of practice for earthing IS 3072 Installation and maintenance of switchgear IS 5133 Box for enclosure of electrical equipment IS 5216 Guide for safety procedure and practice in electrical work IS 13947 Degree of protection provided by enclosures for low voltage switchgear and control gear. IS 5216 Guide for safety procedures and practices in electrical works. IS 800 Code of practice for use of structural steel. 3. 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 thereunder b) Fire insurance regulations c) Regulations laid down by the Chief Electrical Inspector of State and CEA d) Regulations laid down by the Factory Inspector of State e) Any other regulations laid down by the authorities. 4. In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.
1.3.1.9.	TECHNICAL REQUIREMENT FOR ITEMS SUPPLIED BY THE CONTRACTOR.
1.3.1.9.1.	GENERAL

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	1. Equipment and material supplied shall comply with description, rating, type and size as detailed in this specification, drawings and annexures. 2. Equipment and materials furnished shall be complete and operative in add details. 3. All the accessories, fittings, supports, anchor bolts etc., which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished. 4. All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable. 5. Samples of all items shall be made available for purchaser's approval prior to supply of item to site.
1.3.1.9.2.	FERRULES 1. Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter. 2. Ferrules shall be of plastic material. 3. Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave colouring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600 mm. 4. 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.
1.3.1.9.3.	TAGS 1. Cables shall be provided with cable number tags for identification. 2. Cable tags shall be of durable fibre, aluminium or stainless steel sheets. 3. Cable number shall be engraved type in case of aluminium or stainless steel tags, and printed type in case of fibre sheet. 4. Tags shall be durable quality of size 60mm x 12mm with holes at both ends. 5. Samples of tags shall be approved by BHEL Engineer before delivery. 6. Tags shall be provided with non-corrosive wire of sufficient strength for taggings.
1.3.1.9.4.	FIRE STOP CABLE SEALING SYSTEM (AS APPLICABLE)

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	Fire stop cable sealing system shall have two (2) hours fire protection rating suitable for sealing both vertical & horizontal cable penetrations. The sealing compound in conjunction with mineral wool shall form effective fire seals. The sealing compound shall have special property to allow for short circuit conditions. GPG fire stop sealing compo or equivalent sealing compound shall be used.
1.3.1.10.	GUIDELINES FOR ERECTION OF GI PIPES, SUPPORTS & ACCESSORIES 1. For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits. 2. 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. 3. GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end. 4. The entire GI conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the GI pipes entering them. 5. Bends of GI pipes / conduits shall be made without causing damage to the pipes/conduits. 6. Occupancy of conduits shall not be greater than 40%. 7. The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminium or galvanized steel. 8. Transportation and storage of cable drums shall generally conform to the requirements of IS: 1255. 9. 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. 10. The cable drums shall be transported on wheels to the place of work. Note: The tests specified above for all the electrical equipment are not exhaustive. Any other pre-commissioning and field tests not included in the above list but necessary as per relevant standards, Electricity rules, code of practice and instructed by the manufacturer of the equipment shall also have to be carried if deemed necessary shall be carried out as per requirement either within the quoted rates / price or at additional cost. Decision of Engineer in charge will be the final regarding additional cost for testing. The contractor shall take the full responsibility of testing, commissioning, trial run and successful operation of the equipment under overall.

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1.3.2. Guidelines for Installation of C & I Equipments

- 1.3.2.1. 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.
- 1.3.2.2. 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.
- 1.3.2.3. High & Low pressure impulse lines shall not be grouped and run together. Also impulse lines for explosive & inert gases shall not run together.
- 1.3.2.4. Impulse lines of high pressure steam, harmful gases, etc. shall not be brought into the control room, as far as possible.
- 1.3.2.5. Intrinsically safe circuits shall be used for explosion hazardous areas.
- 1.3.2.6. Separate cable routing shall be followed for high and low voltage lines.
- 1.3.2.7. All electrical equipments shall meet the requirements of Indian Electricity Rules.
- 1.3.2.8. Wherever severe vibrations are expected, shock absorbers shall be provided
- 1.3.2.9. Installation of instruments with radioactive isotopes, mercury and other toxic substances shall be as per statutory regulations provided by authorities.
- 1.3.2.10. Compensating cables should be connected directly to instruments, i.e. no junction boxes shall be used if CJCBS are not provided.
- 1.3.2.11. 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.
- 1.3.2.12. Pressure gauges shall be provided with snubbers, syphons (for more than 100°C), three way valve manifolds wherever applicable.
- 1.3.2.13. 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.
- 1.3.2.14. Correct level (height) between detecting element and tapping point and transmitter shall be maintained.
- 1.3.2.15. The equipment shall maintain its normal posture (level, perpendicular, front and back).
- 1.3.2.16. Connection between detecting element/tapping point and transmitter shall be maintained at short distances wherever practicable to avoid any time lag.

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- 1.3.2.17. 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.
- 1.3.2.18. For details of installing each measuring instruments, instruction manual issued by the respective manufacturer of instruments may be referred to, wherever necessary.
- 1.3.2.19. The drain pipes shall be terminated in a common closed header and finally the common header shall be connected to plant open drain.
- 1.3.2.20. 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.
- 1.3.3. **Guide Line for Erection of Impulse Lines**
 - 1.3.3.1. 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.
 - 1.3.3.2. The routing of pipelines shall include sufficient flexibility near tapplings to allow for thermal expansion of the process equipment.
 - 1.3.3.3. The pipes shall be cold bent using hydraulic bending machines only.
 - 1.3.3.4. The horizontal impulse lines shall be laid with proper slopes towards the tapping point.
 - 1.3.3.5. Supports for piping and tubing shall be adequate and in no case exceed limits shown below:
 - a) 1/4" OD / 3/8" OD Copper - Continuous
 - b) 1/2" NB Pipe / Tube - 5'
 - c) 3/4" NB Pipe / Tube - 5'
 - d) 1" NB Pipe / Tube - 8'
 - 1.3.3.6. All impulse line welding shall be done through welding generator/rectifier and only structural welding could be done through welding transformer.
 - 1.3.3.7. 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.
 - 1.3.3.8. 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.
 - 1.3.3.9. 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.

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- 1.3.3.10. 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.
- 1.3.3.11. Alternatively, hose assembly - S.S. flexible may be used for connection between tapping point and impulse pipe.
- 1.3.3.12. The expansion bends are to be avoided as far as possible, as these act as air/sedimentation traps hampering the system performance.
- 1.3.3.13. Impulse piping shall be arranged as short as possible with a minimum of bends.
- 1.3.3.14. Horizontal piping shall be avoided and 1/10 slope shall be maintained.
- 1.3.3.15. Pipes shall not be laid parallel to high temperature process piping.
- 1.3.3.16. 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.
- 1.3.4. **Impulse Piping for Air & Flue Gas System**
 - 1.3.4.1. 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.
 - 1.3.4.2. 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.
 - 1.3.4.3. 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.
- 1.3.5. **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.
- 1.3.6. **Impulse Piping for Steam and Water System**
 - 1.3.6.1. As a rule, instrument installation position for steam and water shall be downward from root valves.
 - 1.3.6.2. Impulse pipes shall have a minimum slope of 1:10 and shall be supported at every 2 metres length.
 - 1.3.6.3. At the transmitter end, the connection can be either through 2-way valve manifold or nipple with coupling.

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- 1.3.6.4. 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.
- 1.3.6.5. Some supplier recommends capillary type tube for transmitter connection from the impulse pipe to instrument by using S.S. tube and compression fittings.
- 1.3.6.6. 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.
- 1.3.6.7. 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.
- 1.3.7. **Bending**
- 1.3.7.1. It is recommended for cold bend for the impulse pipes with the help of a hydraulic bending machine to achieve a particular shape.
- 1.3.7.2. 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.
- 1.3.7.3. 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.
- 1.3.7.4. Large bending shall be so made as to form smooth curve.
- 1.3.8. **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.
- 1.3.9. **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.

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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.

1.3.10. **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. 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.

1.3.11. **Guidelines for Installation of Pneumatic Line**

- 1.3.11.1. Copper tubing shall be connected with Olive type of compression fittings,
- 1.3.11.2. When two or more lines run together, the joint in the adjacent alternate line shall be a offset.
- 1.3.11.3. 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.
- 1.3.11.4. Copper tubing shall not to be bend less than 10 D where is the OD of the copper tube.
- 1.3.11.5. 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.
- 1.3.11.6. 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.
- 1.3.11.7. 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.
- 1.3.11.8. Instrument airline should not be routed where severe vibration, high temperature exists and adequate space should be available for maintenance.
- 1.3.11.9. 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.

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- 1.3.11.10. While using the pipe cutter, care shall be taken to remove burr from the cutting side.
- 1.3.11.11. 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.
- 1.3.11.12. While fixing the copper tube fittings only Teflon tapes should be used. However, no tape shall be used while tightening the ferrules.

1.3.12. **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.

1.3.13. **General Guidelines on Installation of Flexible Hoses**

- 1.3.13.1. 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).
- 1.3.13.2. 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).
- 1.3.13.3. 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.
- 1.3.13.4. 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.
- 1.3.13.5. 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.
- 1.3.13.6. 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.
- 1.3.13.7. 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.

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1.3.14. **General Notes on Installation of Local Instrument Racks and JB Frames**

- 1.3.14.1. In cases where the local instrument stands are to be installed on a concrete foundation, it shall be fixed by anchor bolts.
- 1.3.14.2. 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.
- 1.3.14.3. 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.
- 1.3.14.4. 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 grided or floor grided, as per safety norms.
- 1.3.14.5. Proper care should be taken to ensure that welding of the stand on any structure or Beam is fully welded.

1.3.15. **General Guideline on Flow Instruments Installation**

- 1.3.15.1. 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.
- 1.3.15.2. 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.
- 1.3.15.3. 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.
- 1.3.15.4. 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.
- 1.3.15.5. The Measuring instrument shall be located close to the flow-sensing element. The speed of response is reduced if there is a long run.
- 1.3.15.6. 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 (+)

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is marked on the upstream.

- 1.3.15.7. Location of Flow element should have clear straight run of 10D in upstream and 5D in downstream.
- 1.3.15.8. 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.
- 1.3.15.9. 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.
- 1.3.15.10. If the flow of any dry gases are to be measured, the location of instrument can be kept above or below the tapping points.
- 1.3.15.11. 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.
- 1.3.15.12. The condenser pot should be located nearer to the tapping point and both condenser chamber should be at the level of upper tapping,
- 1.3.15.13. 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.
- 1.3.15.14. 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.
- 1.3.15.15. 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.
- 1.3.15.16. 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.
- 1.3.15.17. The commonly used sealing liquid includes water, light oil, glycerol, ethylene glycol and mixtures of the last two with water.
- 1.3.15.18. The sealing chambers, in each pressure pipe, should be installed at the same level and as close as possible to the pressure tapplings.
- 1.3.15.19. The general arrangement for pressure tapplings from the Sealing Chamber to the instrument is shown in the sketch.

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1.3.15.20. 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.

1.3.16. **General Guideline on Installation of Valves**

1.3.16.1. Primary isolating valves (root valves) must be located at the tapping which can be of globe valves.

1.3.16.2. These valves shall be installed where access is possible.

1.3.16.3. 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.

1.3.16.4. For pressure more than exceeding 40 kg, 2 isolating valves shall be provided.

1.3.16.5. In the case of heavy duty isolating valves, suitable support shall be provided to avoid any loading on the stubs.

1.3.16.6. In viscous fluids, suitable steam tracing shall be provided.

1.3.16.7. These valves are always located as nearer to the measuring device as possible.

1.3.17. **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.

1.3.18. **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.

1.3.19. **GUIDELINES FOR CABLE LAYING**

1.3.19.1. 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.

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- 1.3.19.2. 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.
- 1.3.19.3. 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.
- 1.3.19.4. GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
- 1.3.19.5. In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy-duty PVC pipes shall be provided.
- 1.3.19.6. 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.
- 1.3.19.7. 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.
- 1.3.19.8. 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.
- 1.3.19.9. 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.
- 1.3.19.10. 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.
- 1.3.19.11. Wherever direct heat radiation exists, heat isolating barriers (subject to customer's approval), for cabling system shall be adopted.
- 1.3.19.12. 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.
- 1.3.19.13. If required, a few number of cables in exceptional areas may be directly buried into the earth.
- 1.3.19.14. 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.
- 1.3.19.15. At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.

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- 1.3.19.16. In corrosive atmosphere, PVC conduits shall be used for cables.
- 1.3.19.17. Single core cables, when pulled individually shall be taken through PVC pipes only.
- 1.3.19.18. Laying and installation of power, control and special cables shall generally conform to IS: 1255
- 1.3.19.19. The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
- 1.3.19.20. 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.
- 1.3.19.21. Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.
- 1.3.19.22. 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.
- 1.3.19.23. 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 25m spacing for straight runs or as specified by Engineer for easy identification of cable.
- 1.3.19.24. When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.
- 1.3.19.25. Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.
- 1.3.19.26. 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.
- 1.3.19.27. 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.
- 1.3.19.28. 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.

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- 1.3.19.29. Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:
- HT cables shall be laid in the top tier(s)
 - LT power cables to be laid in the tray(s) below the HT cable trays.
 - LT control cables to be laid in the Tray(s) next below to the LT power cable tray(s)
 - Special control cables including screened control cables to be laid in the bottom most tray(s).
- 1.3.19.30. 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.
- 1.3.19.31. 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:
- Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.
 - LT power cables are mixed up with control cable with clear minimum gap of 150mm between them.
 - LT power cables are mixed up with HT power cables with clear minimum gap of 200mm between them.
 - LT power cables are mixed up with special control cables with clear minimum gap of 200mm between them.
- 1.3.19.32. 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.
- 1.3.19.33. 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.
- 1.3.19.34. 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.
- 1.3.19.35. To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.

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- 1.3.19.36. 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.
- 1.3.19.37. 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.
- 1.3.19.38. 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.
- 1.3.19.39. Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.
- 1.3.20. **Support Spacings & Clampings**
Support spacing and clamping suitably provided and as required.
- 1.3.21. **Laying of cables directly buried in ground**
Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.
- 1.3.22. **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. |

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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.

1.3.23. **Guidelines For Erection of Cable Trays, GI Pipes, Supports and Accessories**

- 1.3.23.1. 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.
- 1.3.23.2. 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.
- 1.3.23.3. 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.
- 1.3.23.4. 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.
- 1.3.23.5. 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.
- 1.3.23.6. Cable trays/racks shall be so arranged that they do not obstruct or impair

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clearances of passage way or maintenance of adjacent equipment.

- 1.3.23.7. For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.
- 1.3.23.8. 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.
- 1.3.23.9. GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.
- 1.3.23.10. 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.
- 1.3.23.11. Bends of G.I. pipes / conduits shall be made without causing damage to the pipes / conduits.
- 1.3.23.12. Occupancy of conduits shall not be greater than 40%.
- 1.3.23.13. The adopter for coupling rigid GI pipe / conduits and flexible conduit shall be of aluminum or galvanized steel.
- 1.3.23.14. Transportation and storage of cable drums
- 1.3.23.15. Transportation and storage of cable drums shall generally conform to the requirements of IS: 1255
- 1.3.23.16. 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.
- 1.3.23.17. The cable drums shall be transported on wheels to the place of work.
- 1.3.24. **Guidelines for Cable Termination and Jointing**
- 1.3.24.1. Contractor shall carry out cable terminations at various electrical and electronic equipment terminals.
- 1.3.24.2. 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 drilling holes. Cutting shall not be allowed.
- 1.3.24.3. 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.
- 1.3.24.4. All cable entries in the equipment shall be sealed after glanding the cables.
- 1.3.24.5. Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core / conductor.

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- 1.3.24.6. 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.
- 1.3.24.7. 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.
- 1.3.24.8. Screened control cables of 0.5 sq.mm cross-sectional area shall be terminated by means of wire rapping system.
- 1.3.24.9. 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.
- 1.3.24.10. 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.
- 1.3.24.11. Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs.
- 1.3.24.12. 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.
- 1.3.24.13. 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.
- 1.3.24.14. Junction boxes shall be used, wherever required, for jointing of control cables.
- 1.3.24.15. 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.
- 1.3.25. **Design Requirements of Items supplied for cabling installation work (if supply is covered in contractor scope).**
 - 1.3.25.1. **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.

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- 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.

1.3.25.2. 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.

1.3.25.3. 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.

1.3.25.4. 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.

1.3.26. GUIDELINES FOR EARTHING INSTALLATION

- 1.3.26.1. All equipment shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.3.26.2. 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.
- 1.3.26.3. 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.
- 1.3.26.4. All joints in the earthing system shall be welded type. Earthing connections to all equipment including motors shall be bolted type.
- 1.3.26.5. Earthing connections shall be free from tinning scale, paint, grease, rust or dirt at the time of making joint.
- 1.3.26.6. Metallic sheaths, screens / shields and armor of all multicore cables shall be bonded and earthed.
- 1.3.26.7. Earthing conductors along with their run on columns, beams, walls etc., shall be supported by suitable cleats at intervals of 750 mm.
- 1.3.26.8. Conduits shall be bonded together and grounded at all switchgear and control centers.
- 1.3.26.9. 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.
- 1.3.26.10. 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.
- 1.3.27. **Guidelines for Erection of Control Panels and Distribution Boards**
- 1.3.27.1. 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 be grouted. Suitable concrete drilling machine shall be used for making hole on the concrete floor.
- 1.3.27.2. 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.
- 1.3.27.3. 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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

with parallel, horizontal and vertical alignment by skilled craftsmen.

- 1.3.27.4. 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.

1.3.28. **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.

1.3.29. **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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 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

1.3.30. **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%

1.3.31. **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.

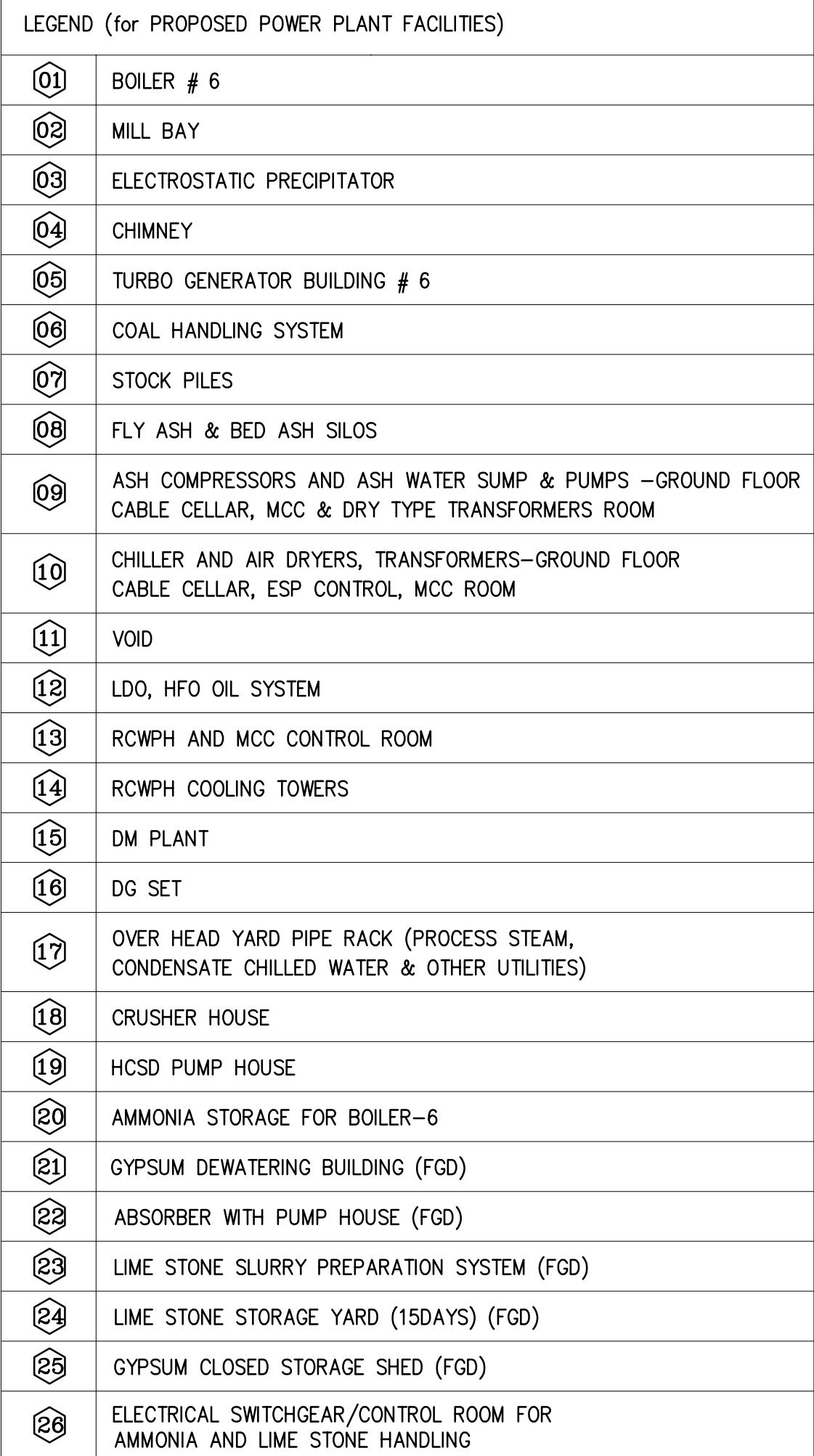
1.3.32. **Guidelines for landing and storage of Electronic Cubicles / sub-assemblies / loose items.**

- 1.3.32.1. 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.
- 1.3.32.2. 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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

details of the damage should be noted. The details of the damage should be reported to the responsible site Engineer.

- 1.3.32.3. 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.
- 1.3.32.4. After opening the case, all supports provided for transport are to be removed with due care.
- 1.3.32.5. 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.
- 1.3.32.6. **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.



DISTRIBUTION		
CUSTOMER		COS
		ENV
CONTRACTOR		MNB
CVL		NFE
ELE		PWR
IAC		CNT
LTL		INS
STR		PRS
UTL		CON
WTS		
COB		CHN-
CRF		CHN-
IRM		CHN-
MMH		MUM-
PML		MUM-
R/LM		PM
STM		SITE



NATIONAL ALUMINIUM COMPANY LIMITED
BHUBANESWAR, ODISHA
INSTALLATION OF STEAM AND POWER PLANT FOR 5th STREAM ALUMINA REFINERY
EXPANSION AT DAMANJODI, ODISHA UNDER PHASE-3 EXPANSION OF M&R COMPLEX
POWER PLANT AREA LAYOUT

REV	DEPT	BY	DATE			
				SCALE	1:3000	DATE
				DSGND. BY	PSK	15.03.2018
				DRAWN BY	KKR	15.03.18
				CHKD. BY	PSK	15.03.2018
				APPVD. BY	RKN	15.03.2018

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This is not to be copied or used for other projects unless expressly permitted by M. N. DASTUR & COMPANY (P) LTD

JOB No. 28812	DRG. No. 28812-000-000-PRJ-0002	REV. C

[illegible]

A	C	11.10.18		FGQ SYSTEM, DB ROOM, 11kV POLE STRUCTURE, AMMONIA STORAGE, UTIL PIPE RACK UPDATED	KKR	RKN
	B	12.09.18		UPDATED BASED ON SITE INFORMATION FOR FGQ & DNOX SYSTEM	KKR	RKN
	A	09.07.18		BUNKERS ADDED	KKR	RKN
	No.	DATE	ZONE	REMARKS	BY	APP.
	REVISION				REFERENCE DRAWINGS	

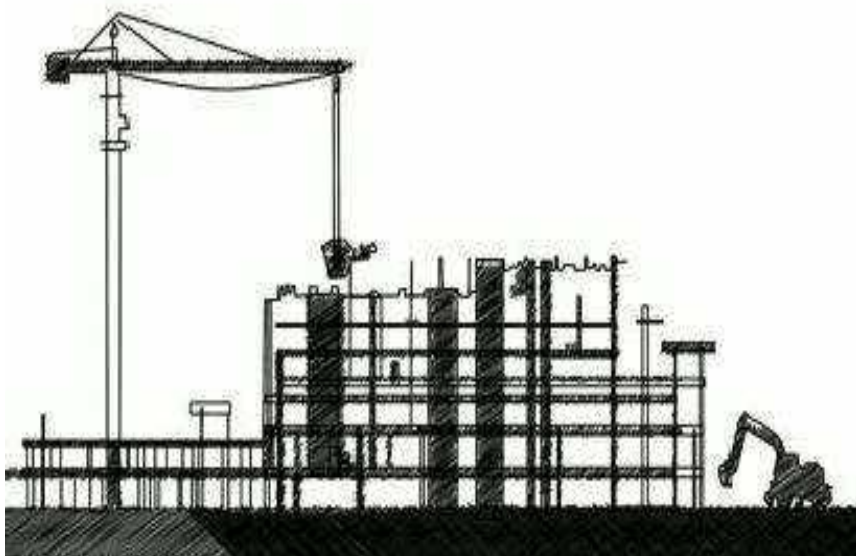
NOTES



HEALTH, SAFETY AND ENVIRONMENT PLAN

For

**SITE OPERATION
For BHEL PSSR
NALCO
DAMANJODI SITE.
1 X 18.5 MW,
BTG PROJECT.**



POWER SECTOR

HSE PLAN FOR SITE OPERATIONS BY BHEL'S SUB-CONTRACTORS

AT A GLANCE

BEFORE START

SIGNING OF MOU

Agree to comply to HSE requirement- Statutory and BHEL's

PLAN

HSE ORGANISATION

Manpower

- 1 (one) safety officer for every 500 workers or part there of
- 1(one) safety-steward/supervisor for every 100 workers
- **Qualification**
As per Cl. 7.1

HSE Roles and responsibilities

- Site In-charge- As per clause 7.2.1
- Safety officer- As per clause 7.2.2

HSE Planning

for Man, Machinery/Equipment/Tools & Tackles

PROVIDE

HSE INFRASTRUCTURE

• PPEs • Drinking Water • Washing Facilities • Latrines and Urinals • Provision of shelter for rest • Medical facilities	• Canteen facilities • Labour Colony • Emergency Vehicle • Pest Control • Scrapyard • Illumination

TRAIN

HSE TRAINING , AWARENESS & PROMOTION

Training

- Induction training
- Height work and other critical areas
- Tool Box talk & Pep Talk

Awareness & Promotion

- Signage
- Poster
- Banner
- Competition
- Awards

COMMUNICATE

HSE COMMUNICATION

Incident Reporting

- Accident- Fatal & Major
- Property damage
- Near Miss

Event Reporting

- Celebrations
- Training
- Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 1.8 meters), Hot Work, Heavy Lifting, Confined Space, Radiography, Excavation (More than 1.5 meters)

SAFETY DURING WORK EXECUTION

• Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works	• Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance

HOUSE KEEPING

WASTE MANGEMENT

TRAFFIC MANAGEMENT

ENVIRONMENTAL CONTROL

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

CHECKS

HSE AUDITS & INSPECTION

• Daily Checks • Inspection of PPEs • Inspection of T&Ps • Inspection of Cranes, Hydra ,Winches & lifting tool and tackles	• Inspection of Height work • Inspection of Welding and Gas cutting • Inspection of elevators etc.

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON-CONFORMANCE

Refer Clause 16

Incremental Penalty

For repeated violation by the same person, the penalty would be double of the previous penalty for repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR NALCO DAMANJODI SITE	Doc no.: HSEP: 14 REV: 01 Date: 31.03.2021
	POWER SECTOR	

HSE PLAN FOR SITE OPERATION FOR

PROJECT: -

BHEL PSSR NALCO DAMANJODI SITE. 1 X 18.5 MW, BTG PROJECT

SCOPE OF WORK: -

SITE WORK FOR COAL FIRED STEAM GENERATOR, TURBO GENERATOR, Sox & NOx Control System & its Auxiliaries along with associated facilities for steam & power Plant under 5th Stream Alumina Refinery Expansion Project at NALCO Damanjodi, Odisha

LOA No:-

REVISION HISTORY SHEET

Date	Revision No	Details of Changes	Reason	Prepared	Reviewed	Approved
20.1.2021	00	First issue	First issue	Sandeep Dalal, SE/HSE-HQ	M. Shrivastava, AGM/HSE/HQ	M. Shrivastava, AGM/HSE/HQ
31.03.2021	01	Second issue	Discussed with consultant (M/s Dastur) to incorporate few points	Sandeep Dalal, SE/HSE-HQ	M. Shrivastava, AGM/HSE/HQ	M. Shrivastava, AGM/HSE/HQ

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19/4/2021

Reviewed By:-
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M. Shrivastava
19.4.2021

मुकेश श्रीवास्तव
MUKESH SRIVASTAV

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M. Shrivastava
19.4.2021

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FOR DASTUR/NALCO

CHECKED BY Page 4 of 141

APPROVED BY

NAME
DESIGNATION
DATE

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ASST. MANAGER SAFETY
27.04.2021

MR. SUBHASH MUKHERJEE
ASST. MANAGER SAFETY
27.04.2021

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NALCO, Damanjodi

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NALCO, Damanjodi



**HEALTH, SAFETY AND ENVIRONMENT
PLAN FOR 1x18.5 MW SPP
BHEL PSSR NALCO DAMANJODI SITE**

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REV: 01

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**HEALTH, SAFETY AND ENVIRONMENT
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1.0 PURPOSE

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.

This document shall be followed by BHEL's Sub-contractor 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.

Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed. In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

The document is applicable for BHEL's Sub-contractor at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces.

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the worksite.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including Sub-contractor in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes in to account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, Hydra, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.

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BHEL POWER SECTOR HSE TARGETS

EXPLOSION FATALITY	ZERO
LOST TIME INJURY FIRE	ZERO
VEHICLE INCIDENTS ENVIRONMENTAL INCIDENTS	ZERO
	ZERO
	ZERO

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Health, Safety & Environment Policy of BHEL

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, contractors 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.

sd/-

CMD, BHEL

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5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, Sub-contractor 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 w h i l e

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M/s _____ shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to 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 with in prescribed time limit.

Signed by authorized representative of M/s-----

Name :

Place & Date:

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6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 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.

6.1.2 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".

6.1.3 MAN-HOURS WORKED

The total number of man-hours worked by all employees including sub-contractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labours. 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.

6.1.4 FIRST AID CASES

First aids are essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

6.1.5 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.

6.1.6 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.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non- Reportable Cases:

An incident, where the injured person is given medical help and discharged for work without counting any lost time.

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REPORTABLE CASES:

In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

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.

6.1.8 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:

$$\frac{\text{Number of Reportable LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.9 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:

$$\frac{\text{Days lost due to LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand man power deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

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7.1 NUMBER OF SAFETY OFFICERS

The Sub-contractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The sub-contractor should deploy sufficient safety officers and safety-steward /Safety-supervisor, as per requirement given above, since very initial stage and add more in proportion to the added strength in work force. any delay in deployment will attract a penalty of Rs.30,000/ per man month for the delayed period.

7.2 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1.	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries
2.	Safety Supervisor (Construction Agency)	A recognized Degree in Science (with Physics & Chemistry) alternatively Degree or diploma in any branch of engineering / tech with full time diploma in Industrial Safety with construction safety as one of the Subjects.	Minimum two years
3.	Safety Steward (Construction Agency)	As a minimum, he shall preferably possess School-leaving Certificate (of Class XII with Physics & Chemistry etc.) and trained in fire fighting as well as in safety/ occupational health related subjects, and preferably have adequate knowledge of the language spoken by majority of the workers at the construction site.	Minimum two years

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7.3 RESPONSIBILITIES

7.3.1 SITE IN-CHARGE OF SUB CONTRACTOR

- Shall sign Memorandum of Understanding (MOU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinators.
- Shall screen all workers for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 1.8 meter should use Safety Harness tied to a lifeline/ stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer/HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under sub-contractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

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- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good house keeping.
- Shall ensure adequate valid fire extinguishers are provided at the worksite.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24v.
- Temporary fencing should be done for open edges if handrails and–railings and toe guards are not available.

7.3.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUB-CONTRACTOR

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Toolbox / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/ dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthy ness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
 - Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits/site inspections.
- 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.
- To decline acceptance of such PPE/safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, Sub-contractor on HSE matters

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8.0 PLANNING BY SUB CONTRACTOR

Monthly planning and review of HSE activities shall be carried out by Sub-contractor as per format No. HSEP:14-F30 jointly along with BHEL.

8.1 MOBILISATION OF MACHINERY/ EQUIPMENT /TOOLS & TACKLES BY SUB CONTRACTOR

- As a measure to ensure that machinery, equipment and tools & tackles 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.
- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:
 - Mobile Cranes & Hydra.
 - Side Booms.
 - Forklifts.
 - Grinding machine.
 - Drilling machine.
 - Air compressors.
 - Welding machine.
 - Generator sets.
 - Dump Trucks.
 - Excavators.
 - Dozers
 - Grit Blasting Equipment.
 - Hand tools.
- Sub-contractor 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 Sub-contractor 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.

8.2 MOBILISATION OF MANPOWER BY SUB CONTRACTOR

- The Sub-contractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The Sub-contractor 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.
- 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.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

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8.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), inadequate numbers, will be made available at site & the irregular use by all concerned will be ensured
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves
8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selection care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS: 8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS: 9473-2002, 14166-1994, 14746-1999	Respiratory Protective Devices

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.

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- Where workers are employed in sewers and manholes, which are in use, the sub-contractor 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
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

- Workmen: Yellow
 - Safety staff: Green or white with green band
 - Electrician: Red
 - Others including visitors: White
- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired / replaced.
 - The issuing agency shall maintain register for issue and receipt of PPEs.
 - The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
 - The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tanks shall be ensured at least once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS 10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- 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.
- Overalls shall be supplied by the sub-contractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every workplace.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

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8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules,1998)

- A medical Centre shall be ensured/ identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical Centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules,1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The Sub-contractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- 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.
- 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.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No.01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The Sub-contractor should conduct periodical first aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:14-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

- a. Height workers
- b. Drivers/ Crane Operators/ Riggers

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- c. Confined space workers
- d. Shot/sand blaster
- e. Welding and NDE personnel

8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project in side the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

8.4.7 PROVISION OF ACCOMODATION/ LABOUR COLONY

- The Sub-contractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each Sub-contractor to handle any emergency

8.4.9 INSECT AND PEST CONTROL

Regular insect//pest control (Mosquito, Snake, Honey bee should be carried out by sub- contractor at all of his site work area, offices, mainly laboratories, canteen, labour colony and stores etc.

8.4.10 SCRAP YARD

- In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

8.4.11 ILLUMINATION

- The Sub-contractor 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.
- Adequate and suitable light shall be provided at all workplaces & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:



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A. Construction Area		
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.	rough measurements etc.	
8.	Fine work like precision assembly, precision measurements etc.	700
9.	Sheet metal works	200
10.	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

- Lamp (handheld) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of break age of lamp.
- Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.

If the Sub-contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the sub-contractor

9.0 HSE TRAINING & AWARENESS

9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL / Sub-contractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)

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- 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.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear & gear requirement shall not qualify to attend.
- On completing attending sub contractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the worksite.

9.2 HSE TOOL BOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of Sub-contractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
- Details of the job being intended for immediate execution.
- The relevant hazards and risks involved in executing the job and their control and mitigating measures.
- Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
- Recent non-compliances observed.
- Appreciation of good work done by any person.
- Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no.HSEP:14-F04
- Tool box talk to be conducted at least once a week for the specific work.

9.3 TRAINING ON HEIGHT WORK

- Training on height work shall be imparted to all workers working at height by in-house/external faculty at least once in a year. The training shall include following topics:
- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ Sub-contractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
- Hazards identification and risk analysis(HIRA)
- Work Permit System
- Incident investigation and reporting
- Fire fighting
- First aid
- Fire-warden training
- EMS and OHSMS
- T & Ps fitness and operation

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- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.
- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

9.5 HSE PROMOTION- SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

9.5.1 DISPLAY OF HSE POSTERS AND BANNERS

- Site shall arrange appropriate posters, banners, slogans in local/ Hindi/English languages at work place

9.5.2 DISPLAY OF HSE SIGNAGE

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

9.5.3 COMPETITION ON HSE AND AWARD

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

9.5.4 HSE AWARENESS PROGRAMME

- Sub-contractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10. HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The Sub-contractor shall submit report of all incidents, fires and property damage to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the sub-contractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no.HSEP:14-F15. Corrective action shall be immediately implemented at the workplace and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 HSE EVENT REPORTING

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photo graphs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

10.3 MONTHLY, WEEKLY, DAILY, HSE ACTIVITY REPORTING

Monthly, Weekly & Daily HSE activities shall be reported by Sub-contractor to BHEL as per formats issued by BHEL from time to time (as for example refer to Format No. HSEP: 14-F31A).

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10.4 ACCIDENT INVESTIGATION

- The sub-contractor should conduct a thorough, proper, unbiased & scientific accident investigation after Every accidents at site. The accident/ incident shall be investigated by a team of Contractor's senior Site personnel (involving Site-in-Charge or at least by his deputy) for establishing root-cause and recommending corrective & preventive actions. Findings shall be documented and suitable actions taken to avoid recurrences shall be communicated to BHEL/Owner.
- Sub-contractor should actively participate & co-operate (means provide manpower and other resources) in accident investigation committees, RCA (root case analysis) committee etc formed by BHEL/Owner.
- Sub-contractor should preserve documents/evidence related with accidents until an accident investigation is completed.
- BHEL shall have the liberty to independently investigate such occurrences and the sub-contractor shall extend all necessary help and cooperation in this regard. BHEL shall have the right to share the content of this report with the outside world.

10.5 HSE DOCUMENTATION

- The sub-contractor shall evolve a comprehensive, planned and documented system covering the following as a minimum for implementation and monitoring of the HSE requirements and the same shall be submitted for approval by BHEL/Owner
 - HSE Organizational chart
 - Site Specific HSE Plan
 - Safety Procedures, forms and Checklist. Indicative list of HSE procedures/Format is attached as Appendix
 - Inspections and Test Plan
 - Risk Assessment & Job Safety Analysis for critical works.
- The monitoring for implementation shall be done by sub-contractor after regular inspections and compliance of the observations thereof.
- However, compliance of HSE requirements shall be the responsibility of the Contractor. Any review/approval by BHEL / Owner shall not absolve sub-contractor of his responsibility/ liability in relation to fulfilling all HSE requirements.

10.6 OCCUPATIONAL HEALTH

- The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.
- For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.
- To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.
- Appropriate respiratory protective devices(hood with respiratory devices) shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.
- Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.
- For jobs like drilling/demolishing/dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers
- To avoid work related upper limb disorders (WRULD) and backaches, Display Screen equipments workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good blood circulation in hands.

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- The Contractor shall arrange health check up (by registered medical practitioner) for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness.
- BHEL/Owner reserves the right to ask the contractor to submit medical test reports. Regular health check-ups are mandatory for the workers assigned with Welding, Radiography, Blasting, Painting, Heavy Lift and Height (>1.8m) jobs. All the health check-ups shall be conducted by registered Medical practitioner and records are to be maintained by the Contractor.



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11.0 OPERATIONAL CONTROL PROCEDURES

All applicable OCPs (Operational control procedures) will be followed by sub-contractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then sub-contractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to Sub-contractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be referred by sub-contractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hotwell / deaerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronization		

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions. While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

- 1) HSE Procedure for Register of OHS Hazards and Risks
- 2) HSE Procedure for Register of Environmental Aspects and Impacts
- 3) HSE Procedure for Register of Regulations

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- 4) Operational Control Procedures
- 5) HSE Procedure for Emergency Preparedness and Response Plan
- 6) Contract documents

11.2 WORK PERMIT SYSTEM

The following activities shall come under Work Permit System

- a. Height working above 1.8 meters
- b. Hot working at height
- c. Confined space
- d. Radiography
- e. Excavation more than 1.5 meter depth
- f. Heavy lifting above 20 ton

Refer Annexure 05 for Work permit formats.

- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
 - Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
 - Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
 - Permit holder shall implement and maintain all control measures during the period of permit. He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

11.3.1 WELDING AND GAS CUTTING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

- Use trolleys and cradles of adequate strength, as far as possible, while moving the cylinders.
- Always keep LPG and other liquefiable gas cylinders in upright position and ensure that they are not knocked over
- Check that the valves of the gas cylinders are lightly shut when not in use.
- Do not release gas from the cylinder unless pressure regulator is fitted to its valve.
- Use gas hoses specially designed for the purpose with standard colour code
- Use proper clamps for hose connections, check leakage from hose connections before starting work. Never use steel wires for clamping.
- Take care that there are no kinks in the hoses and the hoses are laid such that nobody steps on the hoses and these do not get damaged due to activities in progress in the vicinity.
- Use flame flash back arrestors for both end such as torch and gas cylinder to avoid back firing in flammable gas cylinders.
- Open the valve of oxygen gas first and then flammable gas for lighting the torch
- Use friction gas lighters only for lighting the torch. Never use matches for smoldering manila ropes or rags for lighting the torch.
- Protect the gas cylinders and hoses from welding sparks or gas cutting sparks falling on them

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- Ensure that the valve key is easily accessible to close the valve immediately in case of emergency.
- Never crimp the hose for temporary shutting of gas. Always shut the supply through pressure regulators.
- Check the hoses daily for any visible damage. Discard the hoses in which gas had backfired.
- Remove the leaking cylinder of flammable gas immediately to an open space where it is least dangerous to life and property. Intimate the supplier of the cylinder.
- Ensure use of aprons, gloves and other PPE as appropriate.

11.3.2 RIGGING SAFETY

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment when not in use, shall be removed from the original work area so as not to present a hazard to employees.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

- All gas cylinders shall be stored in up right position.
- Suitable trolley shall be used.
- There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends.
- Damaged tube and regulators must be immediately replaced.
- No of cylinders shall not exceed the specified quantity as per OCP
- 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
- When cylinders are transported by powered vehicle they shall be secured in a vertical position.

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11.3.4 DEMOLITION WORK

- Before any demolition work is commenced and also during the process of the work the following shall be ensured:
- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- 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.
- 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 over loaded with debris or materials as to render them unsafe.
- Before commencement of demolition work, permission/permit should be taken from Owner/Consultant.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority (TPI) of BHEL. Sub-contractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc, at workplace. Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the Sub-contractor 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 Sub-contractor shall be responsible for obtaining the same. MSDS should be displayed at site.

11.3.7 ELECTRICAL SAFETY

- A. Providing adequate no. of 24V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- B. Fulfilling safety requirements at all power tapping points.
- C. High/ Low pressure welders to be identified with separate colour clothing. No welders will be deployed without passing appropriate standard holding valid welding certificates. Approved welding procedure should be displayed at workplace.
- D. The sub-contractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- E. All portable electric tools used by the Sub-contractor shall have safe plugging system to source of power and be appropriately earthed.
- F. Only experienced electricians with a valid license by appropriate statutory authority shall be employed by the Sub-contractor to carry out all types of electrical works.
- G. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- H. The Sub-contractor shall use only properly insulated and armored cables which conform to the requirement of Indian
- I. Electricity Act and Rules for all wiring, electrical applications at site. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- J. All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- K. No maintenance work shall be carried out on live equipment.
- L. The Sub-contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- M. Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist" and the report is to be submitted to BHEL safety officer

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- N. 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 place as to caused anger or in convenience to any person or the public
- O. The Sub-contractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical are as.

11.3.8 SHOT BLASTING

Blasting is a specialized job involved a lot of hazards which often lead to accidents. There are many forms of risk associated with blasting work. Before beginning the work, employers should identify the hazards and assign a knowledgeable person who know the functioning of shot blasting machine trained to recognize hazards and with the authority to quick take corrective actions to remove them.

Safety measures should be taken before using shot blasting machine are:

- A. Provide training to shot blasters and support personnel on blasting health and safety hazards how to use control, personal hygiene practices and safe work practices.
- B. Safety Points Before Using Shot Blasting Machine
- C. Shot blasting operation can create a high level of dust and noise. shot blasting material and the surface being blasted may contain toxic materials that are harmful to workers. So respirator masks/helmet and safety glasses should be used to protect against nuisance type dust. Also must cover the worker's head ,neck and shoulder to protect the worker from rebounding abrasive.
- D. Review the blast area and security plan because the blast area is the area having the potential for flying material air overpressure can cause injury to a person. Review the communicating system used between blaster and blast area security personnel.
- E. Ensure that Machine is in good condition, fuel system of the machine is free from leakage. Blaster should be experienced.
- F. Use blast room or blast cabinet for smaller operations. Use restricted areas for non-enclosed blasting operations. Use exhaust ventilation system.
- G. Acknowledge the shot is properly loaded and secured. Steel grit shot have less potential to cause lung damage. So always use less toxic shots blasting material. Always use blasting material that can be delivered with water to reduce dust.
- H. Do not use compressed air to clean as this will create dust in the air. To prevent the spread of any hazardous material we should avoid blasting in windy conditions.
- I. Compressor for shot blasting should have a valid TPI.

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11.3.9 FIRE SAFETY

- A. Providing appropriate firefighting equipment at designated workplace and nominate fire officer/ warden adequately trained for his job.
- B. Sub-contractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- C. 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.
- D. 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.
- E. Non-compliance of the above requirement under fire protection shall in no way relieve the Sub-contractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- F. Emergency contacts numbers must be displayed at prominent locations
- G. 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.
- H. Correct type & required quantity of fire extinguishers and sand bucket should be provided at appropriate locations.
- I. Material storage area should have adequate fire fighting arrangement like fire extinguishers /sand buckets etc.
- J. Material storage area should have some person designated as fire watcher.

11.3.10 OPERATIONAL CONTROL PROCEDURE OF RADIOGRAPHY

- A. Exposure to penetrating radiation from Radioactive Isotopes and other source is becoming more and more pronounced in the construction field.
- B. A couple of decades ago, radioactive sources, used, were comparatively 'mild' and less encountered. With the growing demand of weld joint inspection, metal thickness / flaw determination, liquid level measurement in High temperature / pressure process vessels etc., the use and application of the radioactive sources specially, Y-radiation, has increased considerably.
- C. However, the protection and procedure for work safety and personnel protection have warranted very little basic changes
- D. Atomic Energy authorities have been alert and alive to the situation Well organized and efficient monitoring, controlled operation and rescue / recovery system has been developed and enforced. Some of these are:-
- E. Authorized person obtains all Radioactive Isotopes from BARC (Bhabha Atomic Research Centre, Mumbai) only
- F. Transportation and storage specifications and standards are rigidly monitored and enforced by the authorities.
- G. Any mishap, loss or damage is promptly attended to and rectified by the authorities, immediately on receipt of information.
- H. They promptly and formally collect all isotopes reaching their Half-life stage.

Site requirements for the safe use of field personnel are as follows:

1. Isotope storage – a designated and certified location should be maintained properly with prescribed warning board and fencing.
2. Personnel using the Isotope must be medically checked before being permitted to handle and found fit.
3. They must have a valid BARC certificate for safe handling of Isotopes.
4. They must use a film Badge or Dosimeter as prescribed by the authorities while working with Isotopes.
5. Isotope attached to a metal pencil should be removed from storage only for the optimum period of work.
6. Isotope MUST not be taken out of the container lead pot till actual exposure stage is reached. The exposure time must be calculated beforehand.
7. Ensure radiation monitoring equipment is working, when exposure is in progress.
8. On expiry of the exposure time, the source must immediately be put back in the container.
9. All personnel working with radiation sources must maintain the prescribed safe distance at all stages of work.
10. Isotopes Pencil must be handled by a Collimator or monitoring rod of specified length, to avoid any unsafe proximity to the operator's body.

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11. Isotopes or the pencil should never be touched by hand or allowed to come in contact with body.
12. The area of work must be cordoned for a minimum radius of 10m for a Y-ray Isotope of about 3 C (S.A) and more as the strength – “Specific Activity” of the source, demands. Specified warning Boards MUST be installed adequately around the cordoned area.
13. If an isotope is damaged or lost: a) Immediately seal the working / suspected areas for all traffic, pedestrian or vehicle. b) Do not remove any materials tools, containers, vehicles – anything from the suspected area. Inform BARC Authorities – Radiation Protection, Directorate of Atomic Energy.
14. Keep strict watch till the authorities arrive. The authorities will locate and dispose off the offending isotope. On no account site people or any other persons – except BARC designated personnel – should attempt to recover the lost isotope. Suspected over exposure of any personnel must be reported to medical Centre immediately.
15. On a routine basis: All personnel attached to the radiography / radiometer crew must have prescribed medical check-ups.
16. Dosimeter / film badges must be returned to BARC for processing. Safe exposure dosage for each individual over different time stages – fortnightly, monthly, annually are predetermined and compared against actual exposures. ☐ If a person is over exposed at any time he should be: a) Taken off Radiography / Radiometry work. b) Assigned other duties as advised by doctor. He has no cause for panic. A careful handling and strict observance of precautionary measures.

11.3.11 SCAFFOLDING

- A. Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- B. When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than ¼ horizontal and 1 vertical.
- C. Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or other wise secured, at least 90cm above the floor or platform of such scaffolding or staging and extending along the entire length of the out side and ends there of with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from savor, from swaying, from the building or structure.

Requirements for different types of Scaffolds:

Suspended Scaffold

- D. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- E. Requirements for use are to be pre approved by HSE Head, under a specific Permit to Work.
- F. Rolling Scaffolds
- G. The height of rolling scaffolds shall not exceed three times the minimum base dimension.
- H. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
- I. Adequate help must be provided when moving a rolling scaffold.
- J. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
- K. 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.



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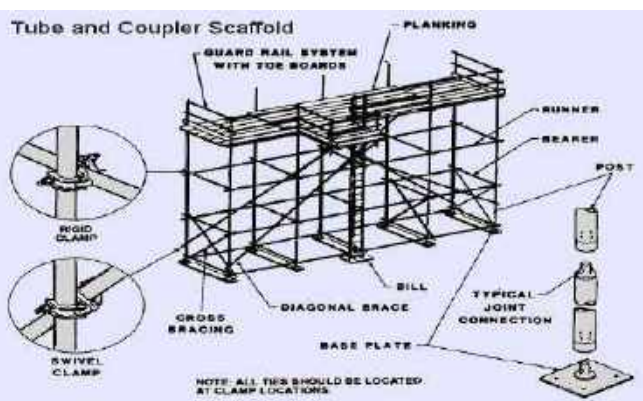
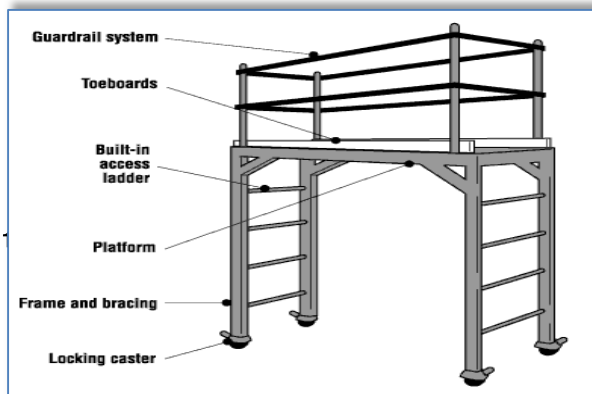


Fig. 13.2.1.3 Types of Scaffolds

Scaffold Tagging:- Scaffolds being erected, modified or dismantled must be tagged as suitable for use. The scaffolds can only be accessed by those involved with the process.

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.

Examples of scaffold tags

- Guard rails and toe-board/ barricades and sound platform conforming to IS:4912-1978 should be provided.
- All workers on job are medically fit for working at height (Person should not have vertigo)
- Where ever necessary, life-line (pp or metallic) and fall arrestor along with Poly amide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057: 1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety net shall be fire resistant, duly tested and shall be of ISI marked and then the net shall be located as per site requirements to arrest or to reduce the consequence of a possible fall of persons working at different heights.
- 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 short cut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use with valid TPI.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on plat forms only.
- In case of roof work, walking ladder/platform should be provided along with life line and /or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged

11.3.12 SAFETY HARNESS, LANYARD, LIFELINE & LIFELINE POST

- 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.

LANYARD

- 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

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appropriate type of system.

- 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.
- 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.

LIFELINE

- All lifelines in general are to be made of min 8/12 mm 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.



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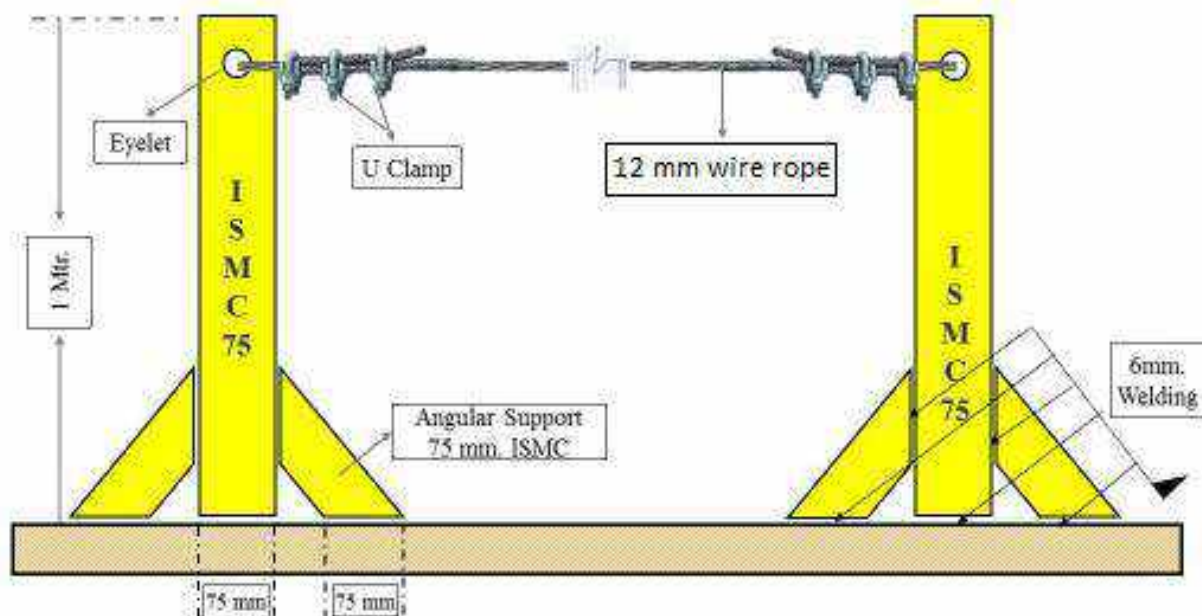
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LIFELINE POST

DIAGRAM : LIFELINE POST



- The support at vertical post shall be fixed at end-to-end. The maximum length of one end to another end shall be 6 meters
- 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
- The lifeline need not be wrapped / clamped to any intermediate post
- Such intermediate posts must be used at an interval of every 6 meters
- The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs.
- In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm
- For a single spun lifeline, no more than 2 persons are allowed to work; for more than two workers, another lifeline should be installed
- Horizontal lifeline should be so installed that it does not impede safe movement of workers
- All the installation work must be carried out by competent person with adequate knowledge

11.3.13 WORKING PLATFORM

- 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 as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

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11.3.14 EXCAVATION

- A. Where ever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.
- B. The following safety measures are to be ensured before and during excavation:
- C. All Excavation activities more than with depth of 1.5 meter or more shall require and Excavation Work Permit
- D. 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
- E. Proper and adequate slope is maintained while excavating
- F. Adequate shoring or sheeting is done wherever require to prevent soil sliding
- G. Safe access through ladder or steps for exit & entry to excavation
- H. No material /excavated soil is kept within one meter from the edge
- I. Safe way is planned and provided for movement of HEM /transport equipment near excavation
- J. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works
- K. Dewatering arrangement is made where water seepage is prevailed.
- L. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
- M. Danger signs /Caution boards are displayed at work spot
- N. Hard Barricading is provided at excavated pits.

11.3.15 LADDER SAFETY

- A. Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app.
- B. 29.2 cm for ladder up to and including 3 m in length.
- C. For longer ladders this width shall be increased at least ¼" for each additional foot of length.
- D. A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.
- E. Ladder should be extended up to 01 meter

11.3.16 LIFTING SAFETY

- A. It will be the responsibility of the sub-contractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.
- B. All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the sub-contractor by engaging only the Competent Persons as per law.
- C. Defective equipment or uncertified shall be removed from service.
- D. Any equipment shall not be loaded in excess of its recommended safe working load.

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11.3.17 HOISTING APPLIANCES

- A. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards.
- B. Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of as suspended load becoming incidentally displaced.
- C. When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- D. The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.3.18 GRINDING SAFETY

- A. Grinders shall be equipped with the 'dead man switch'.
- B. All handheld grinding machines shall be complete with handle or commonly known as the 'T' bar. Removal of the handle during use is strictly prohibited.
- C. Each grinding machine shall be fitted with its correct guard as supplied by the manufacturer, to protect against flying particles.
- D. All pedestal/static grinding machines must have an efficient starting and stopping device, which is easily accessible.
- E. Each grinding machine shall be inspected regularly.
- F. Abrasive wheels, grinding or cutting discs without the manufacturer's maximum RPM marked shall not be used.
- G. Grinding and cutting discs are different in the manufacture and shall therefore only be used for its intended purpose.
- H. Cutting wheel is only allowed for cutting do not do grinding using cutting wheel, chances of breaking.
- I. They shall be stored separately and physically identified to avoid selection error.
- J. Proper PPE, including double eye protection such as the use of goggles underneath of a shatter-resistant face shield and an inhalation mask such as dust mask, Leather gloves shall be worn by all personnel operating grinding machines.
- K. Work areas around pedestal / static abrasive wheels equipment shall be kept clear of obstructions to reduce the risk of tripping hazards.
- L. Cables shall be run neatly in a manner and shall hang on insulated hangers that do not cause tripping hazards.
- M. When changing the grinding disc of the grinder, the power source shall be isolated and the plug physically removed.
- N. Expiry year of shall be visible on the disk. Do not use an expired grinding disk. & do not use a wheel without an expiry date.
- O. Subjected Work-pieces shall be secured using proper clamps. Holding the work piece onto one hand while performing grinding operations is strictly prohibited.
- P. Due to the possibility of a wheel dis integrating during start-up, employees shall be briefed not to stand directly in front of the wheel as it accelerates to full operating speed.
- Q. Worn out / damaged, grinding or cutting disc shall be replaced. When changing the disc, proper tools shall be use.
- R. All worn out / damaged, grinding or cutting disc shall be returned to the stores to ensure that they are dispose of properly.
- S. The power source shall be isolated and the plug physically removed while not in operation.

11.3.19 DRILLING SAFETY

- A. Run drill at correct RPM for diameter of drill bit and material. Ask shop personnel for the correct RPM.
- B. Always hold work in a vise or clamp to the drill table.
- C. Use a correctly ground drill bit for the material being drilled. Shop personnel can help select the correct bit.
- D. Use the proper cutting fluid for the material being drilled. Ask the shop staff about the appropriate fluid for the material you are machining.
- E. Remove chips with a brush, never by hand.
- F. Ease up on drilling pressure as the drill starts to break through the bottom of the material.
- G. Do not use a dull or cracked drill. Inspect the drill before using.
- H. Do not drill with too much pressure.

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- I. Always try to support part on parallels or a backing board when drilling thru material.
- J. Never place taper shank tools such as large diameter drills or tapered shank reamers in a drill chuck. Only straight shank tools such as standard drills can be clamped in chucks.
- K. Always clean drill shank and/or drill sleeve, and, spindle hole before mounting.
- L. Remove taper shank tools from spindle or sleeve with a drill drift and hammer.
- M. Never try to loosen the drill chuck while the power is on.
- N. Lower the drill spindle close to the table when releasing the drill chuck or taper shank drill to reduce the chance of damage should they fall onto the table.
- O. Never clean a machine while it is in motion!!
- P. If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
- Q. When drilling a deep hole withdraw the drill bit frequently to clear chips and lubricate the bit.
- R. Always remove the drill chuck key, or, the drill drift from the spindle immediately after using it.
- S. Wear safety eye protection while drilling.
- T. Let the spindle stop of its own accord after turning the power off. Never try to stop the spindle with your hand.

11.3.20 WEATHER PROTECTION

- A. Contractor shall take appropriate measures to protect workers from severe storms, rain, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, respirators, dust masks, etc. and rearranging/ planning the construction activities to suit the weather conditions. Effective arrangement (without creating inconvenience to project facilities & permanent installations) for protecting workmen from hailstorm, drizzle in the form of temporary shelter may be made at site.

11.3.21 WORKING AT HEIGHT

- A. The Contractor shall issue permit for working (PFW) at height after verifying and certifying the checkpoints as specified in the relevant permit format. He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence of personal protective equipment(s). Contractor's Safety Officer shall verify compliance status of the items of permit document after implementation of action is completed by Contractor's execution / field engineers at work site.
- B. All personnel shall be medically examined & certified by registered doctor, confirming their 'medical fitness for working at height. The fitness examination shall be done once in a year.
- C. The Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing/descending tall structures or vessels / columns etc. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.
- D. The Contractor shall ensure that Full body harnesses conforming relevant IS standard is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall.
- E. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.
- F. The Contractor shall ensure that a proper Safety Net System is used wherever the hazard of fall from height is present. The safety net, preferably a knotted one with mesh ropes conforming to IS 5175/ISO 1140 shall have a border rope & tie cord of minimum 12 mm dia. The Safety Net shall be located not more than 6.0 meters below the working surface extending on either side up to sufficient margin to arrest fall of persons working at different heights.
- G. In case of accidental fall of person on such Safety Net, the bottom most portion of Safety Net should not touch any structure, object or ground.
- H. The Contractor shall ensure positive isolation while working at different levels like in the pipe rack areas. The working platforms with toe boards & hand rails shall be sufficiently strong & shall have sufficient space to hold the workmen and tools & tackles including the equipment required for executing the job. Such working platforms shall have mid-rails, to enable people work safely in sitting posture.

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- I. For steel wire rope type (plastic coated type) life line thickness should of Life lines should be minimum 12 mm or 8 mm (as per job requirement).
- J. Lifelines should be tied to a standard / rigid post.

11.3.22 PROPER ACCESS / EGRESS (ACCESSIBILITY)

- A. The Contractor shall provide safe means of access (in sufficient numbers) & efficient exit to any working place including provisions of suitable and sufficient scaffolding/ramps/steps/ ladders at various stages during all operations of the work for the safety of his workmen and owner/ client.
- B. The Contractor shall implement use of all measures including use of "life line", "fall- arresters", "retractable fall arresters", "safety nets" etc. during the course of using all safe accesses & exits, so that in no case any individual remains at risk of slip & fall during their travel.
- C. Safe access & egress arrangements (e.g. ladders, fall arresters, life-liners etc) should be satisfactorily incorporated
- D. Access / egress to Electrical Distribution Boards / Panels should be clear from wires / cables / earth-strips etc.
- E. The access to operating plant / project complex shall be strictly regulated. Any person or vehicle entering such complex shall undergo identification check, as per the procedures in force / requirement at project site.
- F. Accessibility to 'confined space' shall be governed by specific system / regulation, as established at project site.

11.3.23 HEAVY LIFTINGS

- A. The BHEL Sub-contractor shall submit detailed lifting plan for BHEL /Owner approval prior to lifting equipment which is 20 ton or more
- B. Or any other lift which is of complex dimension (constraints of its dimensions, location of foundation height, approach & weight.) /shape/ or very expensive in nature.
- C. Contractor shall obtain lifting permit before such lifting (e.g HSE-15 "Permit for heavy lift/critical erection")
- D. Prior to actual lifting activities, contractor shall check the validity of the crane/T&P Third party inspection (TPI) certificate issued by statutory/ competent authority. This requirement shall also apply to all lifting equipment utilized for the job.
- E. The Sub-contractor shall, at all times, be responsible for all lifting/rigging activities.
- F. The Sub-Contractor shall ensure medical fitness of all workmen who are engaged/involved in erection of equipment, vessels etc. and such fitness checks shall be carried-out every six months interval with the help of a registered medical practitioner & record shall be maintained.
- G. Adequate safety measures such as positive barricading, usage of appropriate PPEs, permit to work, etc. shall be taken during all heavy or critical lifts.
- H. Crane operators should be experienced & medically fit. They should also posses valid driving license and eye test Report/ Certificate.

11.3.24 LIFTING TOOLS & TACKLES

- A. Lifting tools/tackles, machinery, accessories etc. shall be inspected, tested and examined by competent people (approved by concerned State authorities-TPI) before being used at site and also at periodical interval (e.g. during replacement, extension, modification, elongation/ reduction of machine/parts, etc.) as per relevant statutes. Hydra, cranes, lifting machinery, mobile equipment / machinery / vehicles, etc. shall be inspected regularly by only competent / experienced personnel at site and requisite records for such inspections shall be maintained by every contractor. Contractor shall also maintain records of maintenance of

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11.3.25 HEAVY VEHICLES

- A. The sub-contractor should ensure all statutory compliance of heavy vehicles (e.g Dumper, Truck, Excavator, Crane , Hydra etc) used at construction site like valid RC, Insurance, PUC, etc
- B. The vehicles shall be fitted with reverse warning alarms & flashing lights / fog-lights and usage of seat belts shall be ensured.
- C. Vehicles shall be properly maintained and appropriate maintenance records should be kept.
- D. For Cranes, Hydras Third Party inspections (TPI) by competent person should be done once a year.
- E. In case of Cranes & hydras overload protection device (SLI) (mechanical or electronic) as per possibility should be ensured.
- F. Presence of over hoist protection device should be ensured.

11.3.26 SAFETY DURING INSULATION WORK

- A. Insulation job workers should be given proper PPEs (e.g. nose mask, goggles, hand globe) as per job requirement
- B. Entry to insulation Area should be restricted
- C. Area properly barricaded by the means of caution tapes
- D. After finish of insulation work excess insulation wools should be properly disposed off.

11.3.27 SAFETY DURING HYDRAULIC/ PNEUMATIC PRESSURE TESTING WORK

- A. Sub-contractor should follow appropriate safety guidelines / relevant BHEL OCPs during Hydraulic / Pneumatic Pressure Testing job.
- B. No unauthorized persons should be present near to such work area.

11.4 ENVIRONMENTAL CONTROL

- A. Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal sub-contractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chloro fluoro carbons such as carbon tetra chloride and tri chloro ethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.
- B. 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).
- C. 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 Sub-contractor shall use appropriate MSDS for clean-up technique
- D. All Sub-contractor shall be responsible for the cleanliness of their own areas.
- E. The Sub-contractor shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the Sub-contractor anticipates the generation of excessive noise levels from his operations the Sub-contractor shall inform to Construction Manager of BHEL accordingly so that reasonable & practicable precautions can be taken to protect other persons who may be affected.
- F. It is imperative on the part of the Sub-contractor to join and effectively contribute in joint measures such as tree plantation,

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environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.

- G. The Sub-contractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

11.5 HOUSE KEEPING

- E. Keeping the area clean/free from debris, removed scaffoldings, scraps, insulation /sheeting wastage/ cut pieces, temporary structures, packing woods etc. will be in the scope of the sub-contractor. Such cleanings has to be done daily/weekly/ or as per site requirement by Sub-contractor within quoted rate, by an identified group.
- F. If such activity is not carried out by sub-contractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the subcontractor
- G. Proper house keeping to be maintained at work place and the following are to be taken care of on daily basis.
- H. All surplus earth and debris are removed/ disposed off from the working areas to identified locations.
- I. Unused/ Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- J. All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- K. Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- L. Access and egress (staircase, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- M. Work men shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- N. Labour 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.
- O. Fabricated steel structures, pipes & piping materials shall be stacked properly.
- P. 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.
- Q. Utmost care shall be taken to ensure overall cleanliness and proper upkeep of the working areas

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11.6 WASTE MANAGEMENT

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.

11.6.1 BINS AT WORKPLACE

- Sufficient rubbish bins shall be provided close to work places.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

11.6.2 STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

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11.6.3 SEGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded to public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORK PLACE TRANSPORT SYSTEM (ROAD/ RAIL SAFETY)

- 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.
- 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.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- 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.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

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- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gate ways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- 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.
- For area where Rail lines also present at construction site, appropriate Rail safety guideline issued by BHEL/ Owner should be followed.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS/ ROAD SAFETY

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- 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.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use road way e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 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:

- A high level of stability.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seatbelts.
- Guards on dangerous parts.
- Driver protection to prevent injury from overturning and from falling objects /materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/ LT power lines.
- Valid Pollution Under Control certification for all vehicles

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11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
 - Brakes.
 - Tires.
 - Steering.
 - Mirrors.
 - Windscreen waters.
 - Wipers.
 - Warning signals.
 - Specific safety system i.e. control inter locks
 - Sub contractor should ensure that drivers carry out these checks

11.7.5 STATUTORY COMPLIANCE OF TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized driver with the Administration Department.
- 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.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- On no account I construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing fore man.
- Warning signs shall be displayed during transportation of material.
- All vehicles used shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 MAINTENANCE OF VEHICLES

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.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its sub-contractors
- All the sub-contractor'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. Sub-contractor should nominate is supervisor to coordinate and implement the safety measures.
- Emergency assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.

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- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- 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 it self who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSE MS requirements. The Sub-contractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc. 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 with hold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Sub-contractor 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:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- 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.

12.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:14-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

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12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- 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.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no.HSEP:14-F08

12.4 INSPECTION OF CRANES AND WINCHES

- 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.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators /drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- 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 checklist.

12.5 INSPECTION OF HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
 - Fall arrestor
 - Lifelines
 - Safety nets
 - Fencing and barricading
 - Warning signage
 - Covering of opening
 - Proper scaffolding with access and egress.
 - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness and vertigo test of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION OF WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept up right.
- Use of Flash back arrestor shall be ensured at both ends.



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- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no.HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

12.7 INSPECTION OF ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light <24V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no.HSEP:14-F12.

12.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person(TPI) and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

- The following safety measures are to be ensured before and during excavation:
- All Excavation activities more than with depth of 1.22 meter or more shall require and Excavation Work Permit
- Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage.
- Proper and adequate slope is maintained while excavating
- Adequate shoring or sheeting is done wherever require to prevent soil sliding
- Safe access through ladder or steps for exit & entry to excavation
- No material /excavated soil is kept within one meter from the edge
- Safe way is planned and provided for movement of HEM /transport equipment near excavation
- Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works
- Dewatering arrangement is made where water seepage is prevailed.
- Stop blocks are provided to avoid vehicles reversing into the excavated trenches
- Danger signs /Caution boards are displayed at work spot
- Hard Barricading is provided at excavated pits. It should be made of scaffolding pipe and clamp with reflective nets.
- Trial Trench if required. Cable/Metal detector required for under ground services.

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.

TYPE A SOIL Simple Slope Excavation	TYPE B SOIL Simple Slope Excavation	TYPE C SOIL Simple Slope Excavation

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.

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12.10 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.

Following requirements shall be mandatorily followed, wherever applicable:

- E. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
- F. All tools tackles, lifting appliances; material-handling equipment etc. used by the Sub-contractor shall be of safe design and construction.
- G. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
- H. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over 75% of the crane capacity to be avoided.
- I. Mobile phone should be banned for crane operator and lifting operation. Only walkie talkie shall be allowed in rigging/Lifting purpose.
- J. 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.

LIFTS/ MOVEMENTS LESS THAN 5 TONS:

- K. An equipment rigging plan is not required for lifts less than 5 tons, safety measures are covered in the JSA. Personnel Lifts (Man-Basket / Jhoola):
- L. 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.
- M. 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.
- N. Man-basket shall be used where access through ladders or scaffolding is not feasible.
- O. 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.
- P. 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%.
- Q. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.
- R. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.
- S. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and inspection as other lifting equipment.
- T. 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.
- U. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.
- V. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket remains at that point. The same care shall be taken in its descent. 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.
- W. Use of Rebar steel for making and monkey-ladder must be avoided.



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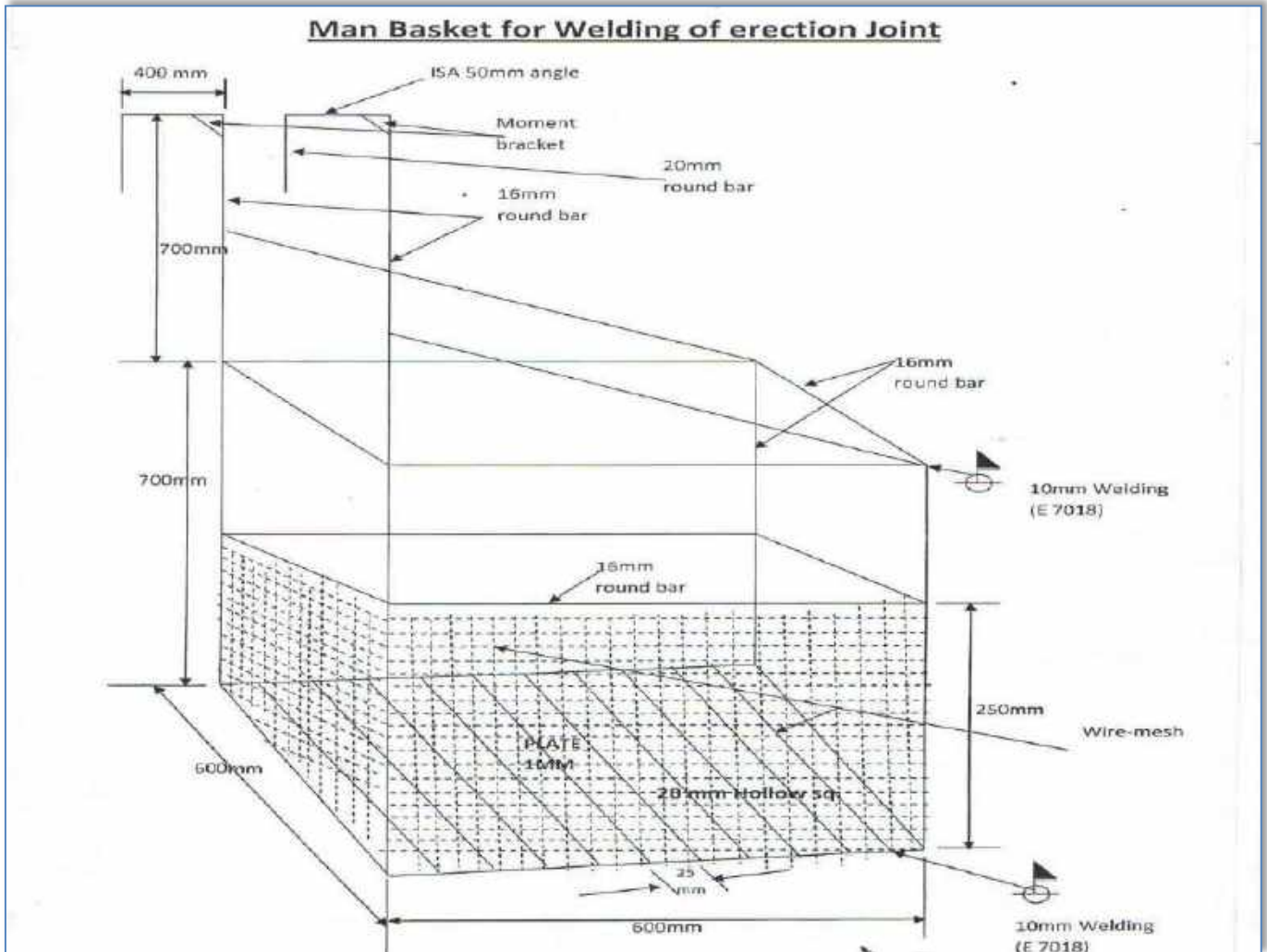
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13.0 HSE PERFORMANCE

- Contractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site. The HSE compliance shall be based on Online HSE Evaluation System of BHEL as per Format No. HSEP: 14-F33.
- BHEL shall reserve the right to use this assessment for evaluating bidder's capacity for future tenders
- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen by the sub-contractor. To decide HSE reward, performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- If safety record of the sub-contractor 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 sub contractor may be considered by BHEL after completion of the job.

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13.1 SAFETY DURING 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 Synchronization and Full loading of unit.
- These activities shall be personally supervised by the site executive along with the commissioning engineer.
- Appropriate Work Permits shall be taken as applicable
- The readiness of upstream and downstream system shall be ensured before taking up.
- 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.
- 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.
- Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
- Electricians with valid wiremen license only shall be permitted to work on power lines.
- The area and the passage shall be adequately illuminated
- Siren/Hooter for alerting workers during steam blowing should be ensured.

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14.0 HSE PENALTIES

- A. As per contractual provision HSE penalties shall be imposed on Sub-contractor for non-compliance on HSE requirement as per format no. HSEP: 14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- B. **If principal customer/ statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the sub-contractor the same shall be passed on to them.**
- C. The penalty amount shall be recovered by Site Finance department from sub-contractor's RA / Final bill.
- D. The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliances and also for repeated failure in implementation of any of the HSE provisions, DASTUR/Owner may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty. The amount of penalty to be levied against defaulted Contractor shall be up to a cumulative limit of:
- E. This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stop-work-instruction and imposition of penalty shall rest with Owner. The same shall be binding on the BHEL sub contractor. Imposition of penalty does not make the Contractor eligible to continue the work in unsafe manner.
- F. The amount of penalty applicable for (penalty by OWNER/CONSULTANT) on the Contractor on different types of HSE Violations is specified below:

Sl. No.	Violation of HSE Norms	Penalty Amount
1	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 500/- per day/Item / Person.
2	Working without Work Permit/Clearance	Rs. 20000/- per occasion
3	Execution of work without deployment of requisite field engineer / supervisor at work spot	Rs. 5000/- per violation per day
4	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads, electrical jobs by incompetent person, etc.)	Rs. 10000/- per item per day.
5	Working at height without full body harness, using day. non-standard/ rejected scaffolding and not arranging fall protection arrangement as required, like hand- rails, life-lines, Safety Nets etc.	Rs. 10000/- per case per
6	Unsafe handling of compressed gas cylinders trolley, jubilee clips double gauge regulator, and not keeping cylinders vertical during storage/handling, not using safety cap of cylinder).	Rs. 500/- per item per day.
7	Use of domestic LPG for cutting purpose / not using flash back arresters on both the hoses/tubes on both ends.	Rs. 3000/- per occasion.
8	No fencing/barricading of excavated areas /trenches.	Rs. 3000/- per occasion.

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	9	Not providing shoring/strutting/proper slope and not keeping the excavated earth at least 1 .5M away from excavated area.	Rs. 5,000/- per occasion
	10	Non display of scaffold tags, caution boards, list of hospitals, emergency services available at work locations.	Rs. 1000/- per occasion per day

15.0 OTHER HSE REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the sub-contractor suitably.
- If the Sub-contractor fails to improve the standard s of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the sub-contractor 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 at the risk and cost of the sub-contractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the Sub-contractor succeeds in carrying out its job in time without any fatal or disabling injury incident and with out any damage to property BHEL may, at its sole discretion, favorably consider to reward the sub-contractor suitably for the performance.
- 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 sub-contractor after holding an appropriate enquiry.
- The su-contractor 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 Sub-contractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the Sub-contractor hereby agrees to indemnify BHEL against the same.
- The Sub-contractor 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 Sub-contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The sub contractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the sub-contractor shall adhere to such instructions.

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15.1 BEHAVIOUR BASED SAFETY

The contractor shall develop a system to implement Behaviour-Based Safety (BBS) through which work groups can identify measure and change the behaviours of employees and workers. **The BBS process shall include the following:**

- A. Identify the behaviours critical to obtaining required safety performance.
- B. Communicate the behaviours and how they are performed correctly to all.
- C. Observe the work force and record safe/at risk behaviours. Intervene with workers to give positive reinforcement when safe behaviours are observed. Provide coaching/correction when risky behaviors are observed.
- D. Collect and record observation data.
- E. Summarize and analyze observation data.
- F. Communicate observation data and analysis results to all employees.
- G. Provide recognition or celebrate when safe behaviour improvements occur.
- H. Change behaviours to be observed or change activators or change consequences as appropriate.
- I. Communicate any changes to workforce

Contractor through its own HSE committee shall implement the above process. The necessary procedures and reporting formats shall be developed by the contractor for approval by Owner. The HSE committee of contractor shall observe individual's behavior for safe practices adapted for utilization/execution of work for following as a minimum:

- PPE
- Tools & equipment
- Hazard Identification & control
- House keeping
- Confined space entry
- Hot works
- Excavation
- Loading & unloading
- Work at height
- Stacking & storage
- Ergonomics
- Procedures

15.2 SLIPS, TRIPS & FALLS

The contractor shall establish a regular cleaning and basic housekeeping programme that covers all aspects of the workplace to help minimize the risk of slips, trips & falls. The contractor shall take positive measures like keeping the work area tidy, storing waste in suitable containers & harmful items separately, keeping passages, stairways, entrances & exits especially emergency ones clear, cleaning up spillages immediately and replacing damaged carpet/floor tiles, mats & rugs at once to avoid slips, trips & falls.

15.3 RADIATION EXPOSURE

- All personnel exposed to physical agents such as ionizing & non-ionizing radiation, including ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.
- For Open Field Radiography works, requirements of Bhabha Atomic Research Centre (BARC)/Atomic Energy Regulatory Board (AERB) shall be followed.

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- The Contractor shall implement an effective system of control (as described in the AFRB regulations) at site for handling radiography-sources & for avoiding its misuse & theft.
- The contractor shall generate the Format No: HSE-8 "Permit for radiation work" before start of work.
- In case the radiography work has to be carried out at day time, suitable methodology to be used so that other works, people are not affected

15.4 DEMOLITION/ DISMANTLING

- The contractor shall adhere to safe demolishing/dismantling practices at all stages of work to guard against unsafe working practices.
- The contractor shall disconnect service lines (power, gas supply, water, etc.)/make alternate arrangements prior to start of work and restore them, if required as directed by DASTUR/Owner at no extra cost.
- Before carrying out any demolition/dismantling work, the contractor shall take prior approval of Owner and generate the Format No.HSE-9. For revamp jobs in operating plants where location of underground utilities is not known with certainty, the contractor shall depute an experienced engineer for supervision and shall make adequate arrangements for Fire fighting & First-Aid during the execution of these activities.
- The Contractor shall arrange approved Job Safety Analysis (JSA) / Method Statement for the specific demolition / dismantling task. In no case any activity related to demolition/dismantling shall be carried out by the Contractor without engaging own supervision / field engineer.

15.5 HSE AWARENESS AND MOTIVATION

- The Contractor shall promote and develop awareness on Health, Safety and Environment protection among all personnel working for the Contractor.
- Regular awareness programs and fabrication shop / work site meetings at least on monthly basis shall be arranged on HSE activities to cover hazards/risks involved in various operations during construction.
- Contractor to motivate & encourage the workmen & supervisory staff by issuing / awarding them with tokens/gifts/mementos/monetary incentives/certificates, etc.

15.6 INTOXICATING DRINKS & DRUGS AND SMOKING

- The Contractor shall not allow any workman to commence any work at any locations of project activity who is/ are influenced / effected with the intake of alcohol, drugs or any other intoxicating items being consumed prior to start of work or working day.
- Awareness about local laws on this issue shall form part of the Induction Training and compulsory work-site discipline.
- The Contractor shall ensure that all personnel working for him comply with "No-Smoking" requirements of the Owner a notified from time to time. Cigarettes, lighters, auto ignition tools or appliances as well as intoxicating drugs, dry tobacco powder, etc. shall not be allowed inside the project/plant complex.
- Smoking shall be permitted only inside smoking area exclusively designated for.

15.7 ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant. Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.

- A. The contractor shall monitor record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.

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- B. Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.
- C. Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant/unit and activities of other contractors.
- D. The contractor shall submit a list of all chemicals/toxic substances that are intended to be used at site and shall take prior approval of the Owner.
- E. Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations/First-Aid measures.
- F. Proper barricading/cordoning of the operational units/plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.
- G. Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.
- H. Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.
- I. Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.
- J. Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.
- K. Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas/ Hydrocarbon shall be done.
- L. Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.
- M. Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.
- N. Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.
- O. The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.
- P. Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.
- Q. Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.
- R. Experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

15.8 CONFINED SPACE ENTRY

The sub-contractor shall generate a work before entering a confined space. People, who are permitted to enter into confine space, must be medically examined & certified by registered doctor, confirming their 'medical fitness for working in confined space. All necessary precautions mentioned therein shall be adhered to. An attendant shall be positioned outside a confined space for extending help during an emergency. All appropriate PPEs and air quality parameters shall be checked before entering a confined space. It shall be ensured that the piping of the equipment which has to be opened is pressure-free by checking that blinds are in place, vents are open and volume is drained. Inside confined space works, only electrical facilities / installations of 24V shall be permitted. Contactor shall ensure usage of safe & suitable arrangement of oxygen supply for individual workmen (during the course of work in confined space), if oxygen concentration is found to be less than 19.5% (v/v) there.

15.9 SCAFFOLDINGS & BARRICADING

Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders or certified (by 3rd

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party competent person) man-basket. When a ladder is used, an extra workman shall always be engaged for holding the ladder.

The Contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. All scaffolds shall be inspected by a competent Scaffolding Inspector of the Contractor. He shall paste a GREEN tag (duly signed by competent Scaffolding Inspector) on each scaffold found safe and a RED tag (duly signed by competent Scaffolding Inspector) on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and Scaffolds with RED ones shall immediately be made inaccessible. Work being found continuing on scaffolds with RED tag shall be considered unauthorized work by Contractor and may invite penalization from BHEL/Owner. For every 120-125 m² /m³ area / volume or its parts thereof minimum one TAG shall be provided.

The Contractor shall ensure positive barricading (indicative as well as protective) of the excavated, radiography, heavy lift, high pressure hydrostatic & pneumatic testing and other such areas. Sufficient warning signs shall be displayed along the barricading areas.

Scaffolding shall be constructed using foot seals or base plates only.

15.10 ELECTRICAL INSTALLATIONS

- All electrical installations/ connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE/applicable international rules & regulations:
- O1SD STD 173:- Fire prevention & protection system for electrical installations
- SP 30 (BIS):- National Electric Code
- All electrical installations shall be approved by the concerned statutory authorities.
- All temporary electrical installations / facilities shall be regularly checked by the licensed/competent electricians of the Contractor and appropriate records shall be maintained in format no: HSE-12" Inspection of temporary electrical booth/installation at project construction site". Such inspection records are to be made available to BHEL/Owner, whenever asked for.

15.11 WELDING/ GAS CUTTING

- Contractor shall ensure that flash back arrestors conforming to BS: 6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use.
- All cylinders shall be mounted on trolleys and provided with a closing key. Empty & filled-up gas cylinders shall be stored separately with TAG, protecting them from direct sun or rain. Minimum 2 nos. of Portable DCP type fire extinguishers (10 kg) shall be maintained at the gas cylinder stores. Stacking & storing of compressed gas cylinders shall be arranged away from DG set, hot works, Elect. Panels / Elec. boards, etc
- The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester/Non Return Valve device.
- The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar.
- At end of work, the cylinders in use shall be closed and hoses depressurized.
- Cutting of metals using gases, other than oxygen & acetylene, shall require written concurrence from Owner.
- All welding machines shall have effective earthing at least at distinctly isolated two points.
- In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.
- The hoses of Acetylene and Oxygen shall be kept free from entanglement & away from common pathways / walkways and preferably be hung overhead in such a manner which can avoid contact with cranes, hydra or other mobile

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construction machinery.

- Hot spatters shall be contained / restricted appropriately (by making use of effective fire- retardant cloth/fabric) and their flying-off as well as chance of contact with near-by flammable materials shall be stopped.
- The Contractor shall arrange adequate systems & practices for accumulation / collection of metal & other scraps and remnant electrodes and their safe disposal at regular interval so as to maintain the fabrication and other areas satisfactorily clean & tidy.
- All gas cylinders must have a cylinder cap on at all times when not in use.

15.12 ERGONOMICS OF TOOLS & TACKLES

- The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health.
- All lifting tools, tackles, equipment, accessories including cranes shall be tested periodically by statutory/competent authority(TPI) for their condition and load carrying capacity. Valid test & fitness certificates from the applicable authority shall be submitted to Owner/DASTUR for their review/acceptance before the lifting tools, tackles, equipment, accessories and cranes are used.
- The contractor shall not be allowed to use defective equipment or tools not adhering to safety norms.
- Contractor shall arrange non-sparking tools for project construction works in operating plant areas / hydrocarbon prone areas.
- Wherever required the Contractor shall make use of Elevated Work Platforms (EWP) or Aerial Work Platforms (mobile or stationary) to avoid ergonomical risks and workmen shall be debarred to board such elevated platform during the course of their shifting / transportation.
- Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.
- The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.
- The Contractor shall arrange periodical training for the operators of hydra, crane, excavator, mobile machinery, etc. at site by utilizing services from renowned manufacturers.

15.13 HSE IMPLEMENTATION, INSPECTION AND MONITORING

- The Contractor shall be fully responsible for planning, reporting, implementing and monitoring all HSE requirements and compliance of all laws & statutory requirements.
- The Contractor shall also ensure that the HSE requirements are clearly understood & implemented conscientiously by their site personnel at all levels at site.
- The Contractor shall ensure physical presence of their field engineers, supervisors, during the continuation of their contract works/site activities including all material transportation activities. Physical absence of experienced field engineers/supervisors of Contractor at critical work spot during the course of work, may invite severe penalization as per the discretion of EIC, including halting /stoppage of work.
- The Contractor shall regularly review inspection report internally and implement all practical steps / actions for improving the status continuously.
- The Contractor shall ensure important safety checks right from beginning of works at every work site locations and to this effect format No: HSE-.10 "Daily Safety Check List" shall be prepared by field engineer & duly checked by safety personnel for conformance.
- The Contractor shall carry out inspection to identify various unsafe conditions of work sites/machinery/equipments as well as unsafe acts on the part of workmen/supervisor/ engineer while carrying out different project related works.

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- G. Adequate records for all inspections shall be maintained by the Contractor and the same shall be furnished to, whenever sought.
- H. The Contractor shall not carry-out work by engaging single worker anywhere without any supervisor anytime during day or night.
- I. As a general practice lifting tools/tackles, machinery, accessories etc. shall be inspected, tested and examined by competent people (approved by concerned State authorities-TPI) before being used at site and also at periodical interval (e.g. during replacement, extension, modification, elongation/ reduction of machine/parts, etc.) as per relevant statutes. Hydra, cranes, lifting machinery, mobile equipments / machinery / vehicles, etc. shall be inspected regularly by only competent / experienced personnel at site and requisite records for such inspections shall be maintained by every contractor. Contractor shall also maintain records of maintenance of all other site machinery (e.g. generators, rectifiers, compressors, cutters, etc.) & portable tools/equipments being used at project related works (e.g. drills, abrasive wheels, punches, chisels, spanners, etc.). The Contractor shall not make use of arbitrarily fabricated 'derricks' at project site for lifting / lowering of construction materials.
- J. Site facilities /temporary. installations, e.g. batching plant, cement godown, DG-room, temporary electrical panels/distribution boards, shot-blasting booth, fabrication yards, etc. and site welfare facilities, like labour colonies, canteen/pantry, rest-shelters, motor cycle/bicycle-shed, site washing facilities, First-aid centers, urinals/toilets, etc. should be periodically inspected by Contractor (preferably utilizing HR/Admin. personnel to inspect site welfare facilities) and records to be maintained.

15.14 LOTO (HAZARDOUS ENERGY CONTROL) PROCEDURES

Hazardous Energy Control Procedures, known as "Lockout/ Tag Out (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. Locks should be used as per requirement or job.

MINIMUM REQUIREMENTS:

The following are minimum requirements that must be included in the Contractor's LOTO program:

Inspection of equipment by a trained individual who is thoroughly familiar with the equipment operation and associated hazards. 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.

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:

- De-energize all sources of hazardous energy:
- Disconnect or shut down engines or motors.
- De-energize electrical circuits.
- Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
- Block or secure machine parts against motion.
- Block or dissipate stored energy.
- Discharge capacitors.
- Release or block springs that are under compression or tension.
- Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere.

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- 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.
- After completion of the work, accomplish the following:
- Inspect repair work before removing the lock and activating the equipment.
- Make sure that only the worker that installed the lock removes his/her assigned lock.
- Make sure that all workers are clear of danger points before re-energizing the system.

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 Sub-contractor working on the Nalco 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.

LOTO 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 OF LOTO RELATED TERMS

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

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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 inadvertent 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 FOR REQUESTING A LOCK OUT / TAG OUT PERMIT

- A. 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.
- B. 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.
- C. 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. 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.

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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 / Tag out 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 / Tag out 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.
- D. Testing shall be performed by person(s) knowledgeable of the energy source(s) being isolated (e.g., an electrician should meter electrical circuits). 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

WORKING UNDER A LOCK OUT / TAG OUT REQUEST

- 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.
- 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",
- When the work activity is finished, personal locks and tags shall be removed and the Safety Representative shall be notified that the Lockout / Tag out 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.

REMOVAL OF LOCKS AND TAGS

- When the lockout / tag out is no longer required, the Safety Representative or Area Supervisor shall obtain the Lockout / Tag out 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 / Tag out Coordinator. Isolation devices may be repositioned at the discretion of the Engineer in Charge according to operational requirements. The Isolator shall complete the Lockout / Tag out Request Permit indicating each lock and tag has been removed and the Safety Representative or Area Supervisor forward to the Lockout / Tag out Coordinator.
- The Lockout / Tag out Coordinator shall discard the tags and maintain the completed Lockout / Tag out Request Permit for future reference.
- 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/Tag out Removal Form, (see Attachment 5), which has been completed by the Area Supervisor.

Employee shall be notified upon returning to the site, prior to beginning any work.

INTERRUPTION OF A LOCKOUT / TAGOUT

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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

- A. 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.
- B. 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.
- C. 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

- A. isolating device. If the energy isolating device will not accept multiple locks or tags, a hasp (a multiple 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
- B. 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.

LOTO 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.

ATTACHMENTS

1. Danger (DO NOT OPERATE) Tags
2. Device & Personal Locks and Multi Lock Hasp:

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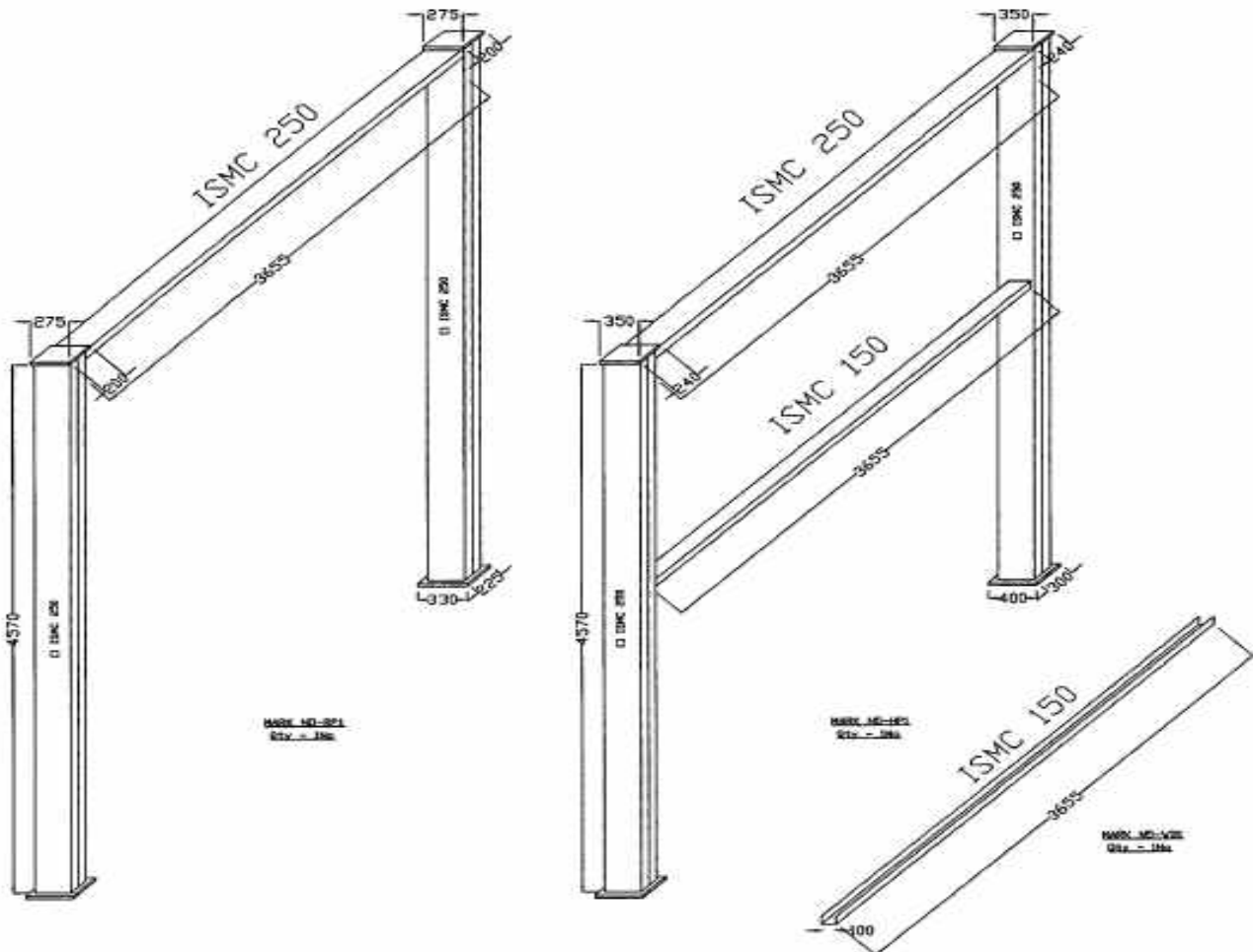
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HEIGHT WORK INDUCTION TRAINING MODULE
STRUCTURE SKETCH (SHEET NO.2)





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BOM FOR HEIGHT WORK INDUCTION TRAINING MODULE

Sl. No.	Description	Width (mm)	Legth (mm)	Qty(No's)	Unit Wt(Kgs).	Total Wt.(Kgs)
MKD NO. WB1						
1	ISMC250		609	3	34.20	62.483
2	ISMC250		914	6	34.20	187.553
3	ISMC100		3655	1	9.56	34.942
4	PL10	100	270	6	78.50	12.717
				Total weight(Kgs)		297.695
MKD NO. RP1						
1	ISMC250		4570	4	34.20	625.176
2	ISMC250		3655	1	34.20	125.001
3	PL25	225	330	2	196.25	29.143
4	PL25	200	275	2	196.25	21.588
				Total weight(Kgs)		800.908
MKD NO. HP1						
1	ISMC250		4570	4	34.20	625.176
2	ISMC250		3655	1	34.20	125.001
3	ISMC150		3655	1	16.80	61.404
4	PL25	300	400	2	196.25	47.100
5	PL25	240	350	2	196.25	32.970
						891.651
MKD NO. LD1						
1	ISA50X50X6		6070	2	4.50	54.630
2	ISA50X50X6		500	12	4.50	27.000
3	PL12	75	75	2	94.20	1.060
4	ISA50X50X6		300	6	4.50	8.100
5	ISA50X50X6		255	2	4.50	2.295
6	ISA50X50X6		1000	8	4.50	36.000
7	ISA50X50X6		910	3	4.50	12.285
8	ISA50X50X6		1100	4	4.50	19.800
9	ISA50X50X6		650	2	4.50	5.850
10	ISA50X50X6		350	2	4.50	3.150
11	PL8	75	900	1	62.80	4.239
12	PL8	75	410	2	62.80	3.862
						178.271
				Total weight(Kgs)		2168.525



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Guidelines for conducting the Height work Induction Training:

1. Walking Bench Training:

- Person should walk over the channel. He should maintain balance & walk without much problem.
- If the person has problem to balance 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:
 - a) Usage of vertical fall arrestor.
 - b) Usage of two lanyards of a safety harness.
 - c) Ensure 3(three) point contact on the ladder while climb.

5. Chair for work at height Training:

- Climb through 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.

Those who pass the above training are fit for height work.

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- 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.

16.0 NON COMPLIANCE (HSE PENALTY BY BHEL)

Non-conformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the sub-contractor as under for every instance of violation noticed:

SL.NO	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Sliding properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

- Legend:-**

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The Sub-contractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same Sub-contractor for the same package in the same unit.

- 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. The amount will be deducted from running bills (RA) of the sub contractor.
- The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

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17.0 HSE AUDIT/ INSPECTION

- Regular HSE Audit shall be carried out by Sub contractor as per Site audit calender.
- HSE checklist (**Annexure 02**) shall be used for carrying out audit/inspection and report shall be submitted to BHEL site management
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.
- Regular HSE inspection shall be carried out by Sub contractor on daily basis.

18.0 MONTHLY/ WEEKLY / HSE COMMITTEE REVIEW MEETING

- Site shall hold HSE review meeting every week/ month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting, its root cause and Corrective action and Preventive action. The agenda is given below:
 - Implementation of earlier MOM
 - HSE performance
 - HSE inspection
 - HSE audit and CAPA
 - HSE training
 - Health check-up camp
 - HSE planning for the erection and commissioning and installation activities in the coming month
 - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site In-charge of Sub-contractors and HSE officer of Sub-contractors.
- MOM on the discussion will be circulated to the concerned for implementation.
- The Contractor shall ensure participation of his top most executive at site (viz. Resident Construction Manager/Resident Engineer/ Project Manager / Site-in-Charge) in Safety Committee / HSE Committee meetings arranged by BHEL/Owner usually on monthly basis or as and when called for. In case Contractor's top most executive at site is not in a position to attend such meeting, he shall inform BHEL/Owner in writing before the commencement of such meeting indicating reasons of his absence and nominate his representative failure to do so may invite very stringent penalization against the specific Contractor, as deemed fit in Contract. The obligation of compliance of any observations during the meeting shall be always time bound. The Contractor shall always assist BHEL/Owner to achieve the targets set by them on HSE management during the project implementation.
- In addition, the Contractor shall also arrange internal HSE meetings chaired by his top most executive at site on weekly basis and maintain records. Such internal HSE meetings shall essentially be attended by field engineers/ supervisors (& not by safety personnel only) of the Contractor and its associates.
- Records of such internal HSE meetings shall be maintained by the Contractor for review by BHEL/Owner or for any HSE Audits.

AGENDA OF INTERNAL HSE MEETING SHOULD BROADLY COVER:

- Confirmation of record notes / minutes of previous meeting
- Discussion on outstanding subjects of previous points /subjects, if any
- Incidents / Accidents (of all types) at project site, if any
- Current topics related to site activities/subjects of discussion
- House keeping
- Behavioral Safety
- Information / views / deliberations of members / site sub Contractors

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- H. Report from Owner /Client
- I. Status of Safety awareness, Induction programs & Training programs
- J. The time frame for such HSE meeting shall be religiously maintained by one and all.

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19.0 FORMATS USED (DETAILS AVAILABLE IN ANNEXURE - 04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01	00
02	Health Check Up	HSEP:14-F02	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	Monthly Site HSE Report	As specified by BHEL	00
06	Inspection of PPE	HSEP:14-F06	00



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07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	HSEP:14-F08	00
09	Inspection of Cranes and Winches	HSEP:14-F09	00
10	Inspection on Height Working	HSEP:14-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:14-F11	00
12	Inspection on Electrical Installation	HSEP:14-F12	00
13	Inspection on Elevator	HSEP:14-F13	00
14	HSE Penalty	HSEP:14-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:14-F15	00

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20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (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 labour 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 Labour 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 labour 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.



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(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 labour 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.

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ANNEXURE 02

HSE AUDIT/ INSPECTION CHECKLIST CUM COMPLIANCE REPORT				
PROJECT: _____		SUBCONTRACTOR: _____		
DATE: _____		OWNER : _____		
_____INSPECTIONBY:				
Note : write 'NA' wherever the items is not applicable				
Item	Y e s	N o	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNEL PROTECTIVE EQUIPMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				



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Angle + 70° from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				



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Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				

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ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSE MSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification



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(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 2003)	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing

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ANNEXURE 04: SAFETY FORMATS

&

ANNEXURE 05: WORK PERMIT FORMATS

	POWER SECTOR	FORMAT NO: HSEP:14-F01 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF FIRST AID BOX	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site: -

Sl. No.	Item	No. Available	Remarks
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of Suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		



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INSPECTION OF FIRST AID BOX

FORMAT NO: HSEP:14-F01
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Sl. No.	Item	No. Available	Remarks
17	Whether 120 ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter)available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti-septic solution available		

Signature of Sub contractor's Site I/C:

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00
	HEALTH CHECK UP	

Name of Site :	
Name of Sub-Contractor:	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy	
	H/O Drug Allergy	
	H/O Diabetics/ Hypertension	
	H/O Unconsciousness	
Personal History		
EXAMINATION		OBSERVATION
<u>General Physical Examination</u>		
Height	:	
Weight	:	
BMI	:	
Built And nourishment	:	
Pallor	:	
Temperature	:	
Chest Expansion	:	Inspiration Expansion
Lymph Node Enlargement	:	
<u>Ear, Nose, Throat</u>	:	
Ear	:	
Nose	:	
Throat	:	

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00
	HEALTH CHECK UP	

EXAMINATION	OBSERVATION
<u>Cardiovascular System Examination :</u>	
Inspection :	
Palpation :	Pulse BP
Auscultation (Heart Sounds) :	
<u>Respiratory System :</u>	
Inspection :	Respiratory Rate
Palpation:	
Percussion :	
Auscultation (Breath Sounds) :	
<u>Examination of Abdomen :</u>	
Inspection :	
Palpation :	
Auscultation (Bowel Sounds) :	
Any Other :	
Clinical Impression	

Signature of the examining doctor

	POWER SECTOR	FORMAT NO: HSEP:14-F03 REV NO.: 00 PAGE NO. 01 OF 01
	HSE INDUCTION TRAINING	

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co -ordinator	

Sl No.	Name	Designation	Organization	Signature

Signature of Training coordinator :

	POWER SECTOR	FORMAT NO: HSEP:14-F04 REV NO.: 00 PAGE NO. 01 OF 01
	TOOL-BOX TALK	

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	Name of person delivered Tool Box Talk	No. of Participants attended	Remarks

Signature of Site I/C of Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F06 REV NO.: 00 PAGE NO. 01 OF 01
	PERSONAL PROTECTIVE EQUIPMENTS	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	Issued this Month	Nos. Issued up to the Month	Percentage of usage at site
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F07 REV NO.: 00 PAGE NO. 01 OF 01
	INSPECTION OF T&Ps	

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs / overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Site Safety Officer (BHEL)	Signature-Subcontractor/ Safety Officer Subcontractor's

	POWER SECTOR	FORMAT NO: HSEP:14-F08 REV NO.: 00 PAGE NO. 01 OF 01
	STATUS OF T&Ps	

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	Nos. Deployed	Identification No.	Nos. Tested by competent person	Validity of Test Certificate
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor:

	POWER SECTOR	FORMAT NO: HSEP:14-F09 REV NO.: 00
	INSPECTION OF CRANES AND WINCHES	
Name of Site :		
Name of Sub-Contractor :		
Inspected by :		
Date of Inspection:		

Crane Reg. No (Make/Model)

Name of Driver/Operator

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch, Overload and SLI of crane/Hydra		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers fully extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		



POWER SECTOR

INSPECTION OF CRANES AND WINCHES

FORMAT NO: HSEP:14-F09
REV NO.: 00

Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				



POWER SECTOR

INSPECTION OF CRANES AND WINCHES

FORMAT NO: HSEP:14-F09
REV NO.: 00

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36" above top landing?		
7	Are built up ladders constructed of sound materials?		



POWER SECTOR

INSPECTION OF HEIGHT WORKING

FORMAT NO: HSEP:14-F10

REV NO.: 00

PAGE NO. 02 OF 02

Sl. No.	Descriptions	Observation (Yes/ No)	Remarks
8	Are rugs and cleats not over 12" on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of Sub-contractor :



POWER SECTOR

INSPECTION OF WELDING AND GAS CUTTING

FORMAT NO: HSEP:14-F11
REV NO.: 00

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Y e s	N o	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			

	POWER SECTOR	FORMAT NO: HSEP:14-F11 REV NO.: 00
	INSPECTION OF WELDING AND GAS CUTTING	

Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	Contents	Yes/No	Remarks
A	Cable		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	DBs/SDBs		
1.	Is earth conductor continued up to DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	ELCB		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		

	POWER SECTOR	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 02 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	Grounding		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	Electrically operated Machines or Accessories.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F13 REV NO.: 00 PAGE NO. 01 OF 01
	INSPECTION OF ELEVATOR	

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs/overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	
Signature-Subcontractor/Subcontractor's Safety Officer		Signature-Site Safety Officer (BHEL)

**POWER SECTOR****Inspection of Excavation**

FORMAT NO: HSEP:14-F13E

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site :

Name of Sub-Contractor :

Inspected by :

Date of Inspection :

Sl.no.	Description	Yes	No	Remarks
1	Precautions taken for Underground Electrical Cable			
2	Precautions taken for Under / Above ground sewer/ Drinking Water Line			
3	Precautions taken for Underground Telecommunication Line			
4	Precautions taken for Underground Product/Utility Line			
5	Precautions taken for Underground Fire Water Line			
6	Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times			
7	Slope Cutting / Angle Maintained			
8	Hard Barricading & Edge Protection provided			
9	Separate Safe Access for Man and Vehicle			
10	Lighting arrangement			
11	Banksman Provided			
12	Required basic PPEs provided			
13	Excavated soil / Construction Material / equipment kept away from the edge.			
14	First aid in attendance.			
15	Other:			
	Total No of YES			

Signature-Subcontractor/ Subcontractor's Safety Officer

Signature-Site Safety Officer (BHEL)

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:14-F14

REV NO.: 00

PAGE NO. 1 OF 02

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slings properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend: -

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The Sub-contractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same Sub-contractor for the same package in the same unit.

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:14-F14

REV NO.: 00

PAGE NO. 2 OF 02

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

Penalty imposed:

1, Rate as per above chart

2. No. of Persons/ machine/ event/labour

3. Total Penalty= 1. X 2.=

Signature:

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name_____

Distribution: 1 Copy: to Sub- contractor,
1 Copy to Site Construction Manager (BHEL)

	POWER SECTOR- HQ	FORMAT NO: HSEP:14-F15 REV NO.:00 PAGE NO. 01 OF 01
	Incident Report (To be submitted within 24 hours of time of incident)	

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				
	NAME		NAME OF MATERIAL / EQUIPMENT / PROPERTY		
	PERIOD OF EMPLOYMENT				
	AGE	YRS	SEX	MALE/ FEMALE	
	MARITAL STATUS		SINGLE / MARRIED		
	OCCUPATION		NATURE OF DAMAGE		
	PART OF BODY INJURED				
	NATURE OF INJURY				
	AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE				
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED)				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :		SIGNATURE OF SITE HSE COORDINATOR		
17	COMMENTS OF HEAD / SOX				
	DATE:		SIGNATURE OF HEAD/SOX		

**POWER SECTOR****Format for Monthly HSE Planning & Review**

FORMAT NO: HSEP:14-F3o

REV NO.: 00

PAGE NO. 01 OF 3

Note: This is a template and can be modified in consultation with BHEL

Name of the Site		Name of the Subcontractor	
Scope of Work		Date	
PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF		PART-B: REVIEW ON	
SN.	Description of HSE Activity& Formats	Plan & Targets for the month	Review
1	Availability of First Aid Box at Required Places and Inspection thereof as per Format: Fo1	Areas 1.	
2	Health check-up as per Format: Fo2	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. ...	
3	Induction training of newly joined workers as per Format: Fo3	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: Fo4	Locations of TBTs & No. of workers 1. ...	
5	PPE usage and issue as per Format: Fo6		
6	Inspection of T&Ps as per Format: Fo7	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: Fo8		
8	Inspection of Cranes & Winches as per Format: Fo9	List of Cranes & Winches & Nos. 1. ...	
9	Inspection of Height Working as per Format: F10	Areas: 1. ...	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. ...	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. ...	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. ...	
13	Inspection of Excavation as per Format: F13E	Locations: 1. ...	



POWER SECTOR

Format for Monthly HSE Planning & Review

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 02 OF 3

SN.	Description of HSE Activity& Formats	Plan & Targets for the month	Review
14	Job Safety Analysis as per Format F32B	Activities: 1. ...	
15	Regular Job Specific Training (Re-training) for workers involved in hazardous activities	Topics/ Hazards & No. of workers 1. ...	
16	Mass housekeeping (HK) drive in work areas	Areas 1. ...	
17	Vertigo Test of Height workers	Minimum No. of workers:	
18	Deployment of qualified HSE Officers as per contract	Location(s) & Nos. 1. ...	
19	Deployment of qualified HSE Stewards as per contract	Location(s) & Nos. 1. ...	
20	Deployment of Safety tools & Equipment (Safety Nets, Lifelines, Fall arrestors, Man-cages, flashback arrestors, scaffolding etc.)	Tool/ Equipment & Location 1. ...	
21	Safety Walks by site in charge of agency (4 -Weekly once)	Dates:	
22	Safety walks by departmental head (8-Weekly twice)	Dates:	
23	Availability/ deployment of Safety posters/ placards/ signage at strategic locations	Locations: Nos. 1. ...	
24	Provision of clean drinking water sources for workers	Locations: Nos. 1. ...	
25	Provision of toilets for workers (separate for male & female workers)	Locations: Nos. 1. ...	
26	Rest sheds for workers during lunchtime, rain, dust storm etc.	Locations: Nos. 1. ...	
27	Availability of following in Labor colony	1. Clean drinking water 2. Toilets 3. Cleanliness & Hygiene 4. Grass cutting, 5. Fogging 6. Electrical Inspection ...	

**POWER SECTOR****Format for Monthly HSE Planning & Review**

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 03 OF 3

SN.	Description of HSE Activity& Formats	Plan & Targets for the month	Review
28	Availability of dust/ waste bins at various locations	Locations: 1. ...	
29	Availability of Ambulance (individual/ joint) in each shift	Ambulance No.	
30	Availability of emergency vehicle in each shift	Emergency vehicle	
31	Deployment/ Availability of tested Fire Extinguishers	Locations & Nos. 1. ...	
32	Tree plantation	Locations & Nos. 1. ...	
33	Waste disposal & Scrap Bins	Locations 1. ...	
34	Illumination checks	Locations 1. ...	
35	Safety award function: 1. Display of good practices Award presentation	Minimum 1 per month	
36	Submission of Daily Reports as per Format No.F31A	Daily Reports (Night & Day Shifts)	

PLAN**REVIEW****Agency**

Name:

Sign:

Date:

BHEL

Name:

Sign:

Date:

Agency

Name:

Sign:

Date:

BHEL

Name:

Sign:

Date:

POWER SECTOR

Format for Daily HSE Reporting

FORMAT NO: HSEP:14-F31A

REV NO.: 00

PAGE NO. 01 OF 1

Note: Following format to be submitted (preferably) in excel/ soft copy by Sub-contractor daily at the end of each shift. Any photographs/ records to attached

Night		Day	SHIFT	Year	Site
			Submitted By		
			Work Area(s)		
			Staff		
			Man-Power		
			Safety Officers		
			Safety Stewards		
			Tool Box (Topics and No. of Participants)		
			Induction Training (No. of Participants)		
			Vertigo Test (Numbers Tested)		
			On-the-Job Training (Topic & participants)		
			Work Permits		
			Job Safety Analyses conducted		
			Height Work Inspection		
			Other Hazardous Activities Inspection		
NA			T&P Inspection (Names & Nos. Inspected)		
			Safety Walk (Designation, Areas)		
NA			HSE Meeting		
NA			Safety Reward (Details)		
NA			Housekeeping/ Dust Suppression/ Tree Pruning		
			Lost time Accident		
			Restricted Work Case		
			Medical Treatment Case		
			First Aid Case		
			Near miss		
			Property Damage/ Fire		
			Non-Compliances Submitted by BHEL		
			Complied by Agency		
			Any other Remarks/ Inputs		



POWER SECTOR

Job Safety Analysis Format

FORMAT NO: **HSEP:14-F32B**

REV NO.: 00

PAGE NO. 01 OF 1

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS					PRECAUTIONS	
(Name)	Submitted By (Agency HSE)		Reviewed By (BHEL Execution)		Approved By (BHEL HSE)	
(Sign)						
(Date)						

**POWER SECTOR- HQ****Checklist for Evaluation of HSE Performance**

FORMAT NO: HSEP:14-F33
 REV NO.:00
 PAGE NO. 01 OF 3

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
1a	Induction training for new workers conducted through audio-visual medium & documented ?	M	1	Induction Training Records
1b	Tool box talk conducted regularly as per plan, and documented?	M	1	Toolbox Talk Records
1c	Contractor in charge and safety in charge attended safety meetings?	M	2	Minutes of Meeting
1d	Whether observations in safety meetings are complied before next meeting?	M	2	-do-
1e	Preparation and submission of Monthly HSE report within stipulated time	M	1	Report submission date
1f	Preparation and submission of Incident/near-miss report and RCA Report (as applicable) within stipulated time	M	1	Incident/ Near Miss Records
1g	Carrying out Inspections and submission of Inspection reports within stipulated time	M	1	Inspection Records
1h	Regular Job Specific Training ensured for High Risk Workers (through audio-visual medium) as per plan	M	1	Training & Attendance Records
2a	Whether the contractor is registered under BOCW	M	2	BOCW Registration Certificate
2b	Availability of Qualified safety officer (1 for every 500 labour)	M	2	Safety Officer qualification & experience records
2c	Availability of Qualified safety supervisor (1 for every 100 labour)	M	2	Safety Officer qualification & experience records
2d	All the workers are provided and using safety helmets and safety shoes/gum boots	M	2	PPE Issue Records, Inspection/ non-conformity records
2e	Housekeeping done on regular basis and scrap removal at site	M	1	Housekeeping records, Inspection/ non-conformity records
2f	Usage of Goggles/Face shields and Hand gloves for gas cutter and grinders		1	PPE Issue Records, Inspection/ non-conformity records
2g	Wall openings & floor openings are guarded?		1	Inspection/ non-conformity records
2h	Adequate illumination provided in all working area?		1	Inspection/ non-conformity records
2i	Safety posters, sign boards and emergency contact numbers in all prominent location are displayed?		1	Inspection/ non-conformity records
2j	Availability of automatic reverse horns, Main horn, hook latches for Vehicles, mobile cranes, Hydras		1	Inspection/ non-conformity records
2k	Ban of carrying mobile phones to work place is implemented for workers		1	Inspection/ non-conformity records
2l	Availability of Tags & Inspection Certificates for Cranes of all capacities		1	Master T&P List with internal & external test details
2l.2	Availability of Tags & Inspection Certificates for Winches of all capacities		1	Master T&P List with internal & external test details
2l.3	Availability of Tags & Inspection Certificates, color coding for Chain pulley blocks		1	Master T&P List with internal & external test details
2l.4	Availability of Tags & Inspection Certificates for Vehicles - Trailers, Dozers, Dumpers, Excavators. Mixers etc.		1	Master T&P List with internal & external test details
2l.5	Availability of Tags & Inspection Certificates for Welding machines, grinders, Drilling machines, etc.		1	Master T&P List with internal & external test details
2l.6	Availability of Tags & Inspection Certificates, colour coding for Wire rope slings etc.		1	Master T&P List with internal & external test details
2l.7	Availability of Tags & Inspection Certificates for Batching plants		1	Master T&P List with internal & external test details

POWER SECTOR- HQ

**POWER SECTOR- HQ****Checklist for Evaluation of HSE Performance**FORMAT NO: HSEP:14-F33
REV NO.:00
PAGE NO. 03 OF 3

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
7a	Whether Scaffolding pipes made with steel or aluminum, are being used and checked periodically by experienced/ certified scaffolder?		2	Inspection/ non-conformity records
7b	8mm Stainless Steel wire rope with plastic cladding is provided for life line (Vertical / Horizontal) during height work?		2	-do-
7c	Availability of emergency lighting in case of power failure		1	-do-
7d	Whether all the openings are covered with Safety Nets made of fire proof Nylon?		1	-do-
7e	Whether MS pipe rails around staircases & platforms in usage are provided with top, middle rails and toe guard ?		1	-do-
7f	Whether Ladder with vertical life line /Fall arrestor is available to climb?		1	-do-
7g	Whether all workers deployed for working at height have been issued height pass after undergoing vertigo test?		1	Height Pass records
7h	Whether all workers deployed for height work / climbing ladder are provided and using Double lanyard safety belt?		1	PPE Issue records, inspection/ non-conformity reports
7i	Is all hand tools/Small material used by height workers is tied firmly to prevent fall?		1	-do-
8a	Flash back arrestors for all gas cutting sets is available on Torch side and cylinder side		1	Inspection/ non-conformity records
8b	Oxygen/Acetylene/LPG cylinders not in use have caps in place and stored separately?		1	-do-
8c	Availability of Face screen, Hand gloves, and Apron, for welders		1	-do-
8d	Protection from falling hot molten metal during metal cutting / welding at height by providing GI sheet below the cutting area especially in fire prone areas		1	-do-
9a	Pre-employment medical check-up done for all workers and submitted?		1	Medical check records
9b	Availability of first aid center, with MBBS doctor(Own or Sharing basis)	M	2	Attendance records
9c	Availability of Ambulance facility 24 hours (Own or sharing basis)	M	2	-do-
9d	Is First aid trained personnel's are available and their names are displayed at site?	M	1	-do-
9e	Availability of Emergency vehicle at site		1	
9f	Periodical medical check-up is conducted for all the workers and submitted?		1	Medical check records
9g	Availability of sufficient number of first aid box as per standard list and maintaining record		1	Inspection records
10a	Availability of Fire extinguishers, buckets at all vulnerable points		2	Fire extinguisher records
10b	Periodic fire mock drill conducted?		1	Fire, Mock drill records
10c	Are all flammable materials are stored separately?		1	
10d	Periodic grass cutting is done in material storage area?		1	
10e	Availability of 24V DC lighting in confined space work area		1	
10f	Availability of exhaust fan in confined space work area		1	

Note:

- **M: Mandatory; O: Optional.** Points other than mandatory can be excluded with appropriate justification (scope etc.) by BHEL
- Additionally: 30 Marks for each Fatal Accident and 10 mark for each major accident shall be deducted.



BURNING/ WELDING / HOT WORK PERMIT

Area: _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In-charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition. Name

of Work performing Authority: _____ *Sign:* _____ *Date:* _____ *Time:* _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site

Second Copy –BHEL SAFETY

Third Copy :Contractor



LIFTING ACTIVITY PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: Name of Work

Performing Contractor: _____

Name of Package In-charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked and in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____ Name of

BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site

Second Copy –BHEL SAFETY

Third Copy :Contractor



WORKING AT HEIGHT PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____ Name of BHEL

Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ Sign: _____ Date: _____ Time: _____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issue)

Original at BHEL site

Second Copy – BHEL SAFETY

Third Copy : Contractor

CONFINED AREA WORK PERMIT

Exact Location of Work: _____

Nature / Description of Work: _____

Duration of Work Execution *: From Date: _____ to Date: _____ Daily from _____ hrs. to _____ hrs.

Name of Agency Performing the Work: _____

Name of Agency's Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Agency's Package In-charge: _____ Sign: _____ Date: _____

The above described work will be done under all the safety precautions mentioned on this permit to work as under during the currency of the Permit.

No.	Item	Yes	Not required / Remarks
1.	Has the equipment been Isolated from Power/Steam/Air?		
2.	Has the equipment been Isolated from liquid or gasses?		
3.	Has the equipment been de-pressurized &/or drained?		
4.	Has the equipment been Blanked/blinded or disconnected?		
5.	Has the equipment been water flushed &/or steamed?		
6.	Whether man ways open and ventilated?		
7.	Whether constant Inert gas flow arranged?		
8.	Whether mechanically ventilated and adequately cooled?		
9.	Whether 24 V lighting provided inside the confined space?		
10.	Whether Radiation sources removed?		
11.	Whether training on confined space provided to the group?		
12.	Whether required PPEs used?		
13.	Whether Dust/Gas/Air Line mask used?		
14.	Whether attendant with SCBA/Air mask available?		
15.	Whether grounded air Exhaust/Blower/ AC provided?		
16.	Whether Personal Gas alarm provided?		
17.	Whether communication Equipment Provided?		
18.	Whether rescue equipment/team available?		
19.	Whether firefighting arrangement done		
20.	Emergency response team & Medical Facilities available.		
21.	Work hazards are identified, controlled and communicated to the worker.		
22.	Method Statements/ Job Safety Analyses attached:		
23.	Other:		
24.	List of Other Permits Required for the Activity (Attached):		

The conditions mentioned in the above checklist are sufficient for safe completion of this activity. These have been checked and found complied before issuing the Permit, and shall be monitored and ensured throughout the currency of this Permit.

A. Permit Requester/ Receiver (Agency):

Site Engineer:	
Signature: _____	
Name: _____	Designation: _____

Site HSE Officer:	
Signature: _____	
Name: _____	Designation: _____

B. Permit Issuer (BHEL):

Site HSE Officer / Authorized Representative:	
Signature: _____	
Name: _____	Designation: _____

Site Engineer / Authorized Representative:	
Signature: _____	
Name: _____	Designation: _____

C. Package-in-charge (BHEL):

Signature: _____	
Name: _____	Designation: _____

(* Permit valid for 14 days as per overleaf format)

Original: Permittee

2nd Copy: Agency Deptt. HDS3rd Copy: BHEL Site HSE

P.T.O.

Page 1 of 2



LOCKOUT TAGOUT WORK PERMIT

Exact Location of Work: _____

Nature / Description of Work: _____

Duration of Work Execution *: From Date: _____ to Date: _____ Daily from _____ hrs. to _____ hrs.

Name of Agency Performing the Work: _____

Name of Agency's Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Agency's Package In-charge: _____ Sign: _____ Date: _____

The above described work will be done under all the safety precautions mentioned on this permit to work as under during the currency of the Permit.

Tag No.	Device to be Tagged / Locked I.D. No.	Device Location	Device Position OPEN / CLOSED - ON/OFF	Lock No.	Tag Lock Placed by Name/Sign - Date/Time	Tag/Lock Removed by Name/Sign - Date/Time

No.	Item	Yes	Not required / Remarks
1.	Emergency response team & Medical Facilities available.		
2.	Work hazards are identified, controlled and communicated to the worker.		
3.	Method Statements/ Job Safety Analyses attached:		
4.	Other:		
5.	List of Other Permits Required for the Activity (Attached):		

The conditions mentioned in the above checklist are sufficient for safe completion of this activity. These have been checked and found complied before issuing the Permit, and shall be monitored and ensured throughout the currency of this Permit.

D. Permit Requester/ Receiver (Agency):

Site Engineer:
Signature:
Name: Designation:

Site HSE Officer:
Signature:
Name: Designation:

E. Permit Issuer (BHEL):

Site HSE Officer/ Authorized Representative:
Signature:
Name: Designation:

Site Engineer/ Authorized Representative:
Signature:
Name: Designation:

F. Package-in-charge (BHEL):
Signature:
Name: Designation:

(* Permit valid for 14 days as per overleaf format)

Original: Permittee

2nd Copy: Agency Deptt. HOS

3rd Copy: BHEL Site HSE



**HEALTH, SAFETY AND ENVIRONMENT PLAN
FOR 1x18.5 MW SPP
BHEL PSSR NALCO DAMANJODI SITE**

Doc no: HSEP:14

REV: 01

Date: 31.03.2021

POWER SECTOR

DEMOLISHING/ DISMANTLING WORK PERMIT

Project : Sr. No. :
Name of the work : Date :
Name of contractor : Job No. :
Name of sub-contractor : No. of workers to be engaged:
(List enclosed with name & gate
pass numbers)

Line No./Equipment No./Structure to be dismantled:

Location details of dismantling/demolition with sketch: (clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit:

Sl. No.	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc disconnected		
2.	Dismantling/Demolishing method reviewed & approved		
3.	Usage of appropriate PPEs ensured		
4.	Precautions taken for neighbouring structures		
5.	First-Aid arrangements made		
6.	Fire fighting arrangements ensured		
7.	Precautions taken for blasting		

(Contractor's Supervisor)

(Contractor's Safety Officer)

Permission is granted.

(Permit issuing authority)

Name :

Date:

Completion report:

Dismantling/Demolishing is completed on Date at Hrs.

Materials/debris transported to identified location
(as applicable)

☐

Tagging completed

☐

Services like power, gas supply, water, etc restored

☐

(Permit issuing authority)

CONTRACTOR'S NAME



**HEALTH, SAFETY AND ENVIRONMENT PLAN
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POWER SECTOR

SAFETY WALK-THROUGH REPORT

(Name & signature of walk through performer to be inserted
at the bottom of each page)

Project : _____ Report no. : _____
Date : _____ Contractor : _____
Inspection by : _____ Owner : _____
Frequency : Monthly Job no. : _____

Note: Write 'NA' wherever the item is not applicable.

Sl. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
1.	Housing Keeping				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and walkways clear				
d)	General neatness of working areas				
e)	Other				
2.	Personnel Protective Equipment				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Foot protection				
e)	Hand protection				
f)	Respiratory masks etc.				
g)	Full body harness conforming to CC, EN 361				
h)	Hard hat (HDPE)				
i)	Other				
3.	Excavations/Openings				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Other				

Safety walk-through performer (Name & Signature).....



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POWER SECTOR

(continued)

S1. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
4.	Welding & Gas Cutting				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Live electrode bits contained properly				
f)	Fire extinguisher (s) accessible				
g)	Other				
5.	Scaffolding & Barricading				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Positive barricading for critical activities				
g)	Installation of warning signs				
h)	Other				
6.	Ladders				
a)	Extension side rails 1 m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle $\pm 70^\circ$ from horizontal				
e)	Other				
7.	Hoists, Cranes and Derricks				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance log-books maintained				
d)	Outriggers used				
e)	Reverse horn installed/ active/coupled with gear				

Safety walk-through performer (Name & Signature)



**HEALTH, SAFETY AND ENVIRONMENT PLAN
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POWER SECTOR

(continued)

Sl. No.	Item	Satisfactory / Yes	Non satisfactory / No	Remarks	Action
f)	Signs/barricades provided				
g)	Signals observed and understood				
h)	Qualified operators				
i)	Other				
8.	Machinery, Tools and Equipment				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Other				
9.	Vehicle and Traffic				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Other				
10.	Temporary Facilities				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Other				
11.	Fire Prevention				
a)	Personnel trained & instructed to make use of facility				
b)	Fire extinguishers checked periodically & record maintained				
c)	No smoking in Prohibited areas				
d)	Fire Hydrants not obstructed				
e)	Regular fire drill conducted				



**HEALTH, SAFETY AND ENVIRONMENT PLAN
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POWER SECTOR

(continued)

Sl. No.	Item	Satisfactory / Yes	Non-satisfactory/ No	Remarks	Action
12.	Electrical				
a)	Use of 3-core armored cables everywhere				
b)	Usage of 'All insulated' or 'double-insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (Main DB)				
e)	Continuity and tightness of earth conductor				
f)	Effective covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards maintained				
i)	DCP extinguishers arranged & licensed electrician engaged at site				
13.	Handling and Storage of Materials				
a)	Safely stored or stacked				
b)	Passageways clear/free from obstructions				
c)	Fire fighting facility in place				
14.	Flammable Gases and Liquids				
a)	Containers clearly identified/protected from fire				
b)	Safe storage & transportation arrangement made				
c)	Fire extinguishers positioned nearby				
d)	Facilities kept away from electric spark, hot spatters & ignition source				



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POWER SECTOR

(continued)

Sl. No.	Item	Satisfactory /Yes	Non-satisfactory/ No	Remarks	Action
15.	Working at Height				
a)	Approved Erection plan and work permit in place				
b)	Safe access, Safe work platform & Safety nets provided				
c)	Life lines, Fall arrester, Full body harness with double lanyards used				
d)	Health Check record available for workers going up?				
e)	Protective handrails arranged around floor openings				
16.	Confined Space				
a)	Work Permit obtained from requisite authority				
b)	Test for toxic gas and sufficient availability of oxygen conducted & status				
c)	Supervisor present at site & at least one person outside the confined space for monitoring deputed				
d)	Availability of safe means of entry, exit and ventilation (register for entry & exit maintained)				
e)	Fire extinguisher and first-aid facility ensured				
f)	Lighting provision made by using 24V Lamp				
g)	Proper usage of PPEs ensured				
17.	Radiography				
a)	Proper storage and handling of source as per BARC/AERB guidelines (authorized radiographer available)				
b)	Work permit obtained				
c)	Cordoning of the area done				



**HEALTH, SAFETY AND ENVIRONMENT PLAN
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(continued)

Sl. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
d)	Use of appropriate PPE's ensured				
e)	HSE training to workers/supervisors imparted during the fortnight (indicate topic)				
f)	Minimum occupancy of workplace ensured				
18.	Health Checks				
a)	All Workers medically examined and found be fit for working at heights (slinging, rigging, painting etc.) in confined space in excavation/trenching in shot blasting				
b)	Availability of First Aid box with contents				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness at site &labour camps				
f)	Availability of Potable drinking water for workmen & staff				
g)	Provision of crèches for children				
h)	Stand by vehicle / ambulance available for evacuation of injured				
19.	Environment				
a)	Chemical and Other Effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Sea water used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc no: HSEP:14 REV: 01
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(continued)

Sl. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
e)	Waste from Canteen, offices, sanitation etc disposed properly				
f)	Disposal of surplus earth, stripping materials, Oily rags and combustible materials done properly				
g)	Green belt protection				

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc no: HSEP:14 REV: 01
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ACCIDENT/INCIDENT REPORT

(To be submitted by Contractor after every Incident/Accident within 24 hours to DASTUR/Owner)

Report No. : _____ Date : _____

Project site : _____ Name of work : _____

Contractor's name : _____ Contractor's Job
 Engineer (Name) : _____

Non-disabling injury (Non-LTA)	Hospitalized but resumed duty before end of 48 hrs	
Disabling injury (other LTA)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTA)	Death/Expiry	
First Aid case (non LTA)	Resume duty after first aid	

Name of the injured: Father's name of victim:

Sub-contractor's Name:

Gate Pass No.: Age: Yrs.

Victim's medical fitness exam. (Pre-empl.) date:

Date & time of Accident/Incident:

Name of Witness: (1) (2) (3)

Profession of victim:

Bar Bender		Carpenter		Meson	
Fitter		Helper		Gas Cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c. Operator	
Engineer		Manager		Others (specify)	

Qualification:

No formal education		Non-Matriculate		Matriculate	
Graduate		Post-graduate		Others (specify)	

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc no: HSEP:14 REV: 01
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(continued)

Job Experience:

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened:

Activity/works that was continuing during incident/accident:

Excavation		Demolition		Concrete carrying	
Concrete pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Others (specify)	

What exactly the victim was doing just before the incident/accident ?

.....

Nature of Injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Others (specify)			

Parts of body involved in incident/accident:

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Trunk (Abdomen/ Back/ Chest/ Shoulder)		Throat	
Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Others (specify)	

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc no: HSEP:14 REV: 01
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Accident type:

Struck against		Struck by		Fall from elevation	
Fall on same level		Caught in		Caught under	
Caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./Extremes)		Contact with chemicals or oils		Vehicle accident	
Others (specify)					

Medical Aid provided (indicate specific aids/treatment etc):

.....

Actions taken to prevent recurrence of similar incident/accident:

.....

Intimation to local authorities (Dist. Collector/Local Police Station/ESI Authority)
 : Yes/No/NA. If yes, to whom

.....

Safety Officer
 (Signature and Name)
 Stamp of Contractor

Site Head/Resident Construction Manager
 (Signature and Name)

To: Owner
 RCM/Site-in-Charge DASTUR (3 copies)

Divisional Head (Construction) through RCM



**HEALTH, SAFETY AND ENVIRONMENT PLAN
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POWER SECTOR

Date: 31.03.2021

Project Manager, DASTUR, through RCM

**SUPPLEMENTARY INCIDENT/ACCIDENT INVESTIGATION REPORT
TICK THE APPROPRIATE ONE AS APPLICABLE (Furnish within 72 hours)**

Supplementary to Incident/Accident Report No. (Copy enclosed)

Report No.: _____ Date: _____

Project site: _____ Name of work: _____

Contractor's name : _____ Contractor's Job
Engineer (Name): _____

Non-disabling injury (Non-LTA)	Hospitalized but resumed duty before end of 48 hrs	
Disabling injury (other LTA)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTA)	Death/Expiry	
First Aid case (non LTA)	Resume duty after first aid	

Name of the injured: Father's name of victim:

Sub-contractor's Name:

Gate Pass No.: Age: Yrs.

Victim's medical fitness exam. (Pre-empl.) date:

Date & time of Accident/Incident:

Name of Witness: (1) (2) (3)

Profession of victim:

Bar Bender		Carpenter		Meson	
Fitter		Helper		Gas Cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c. Operator	
Engineer		Manager		Others (specify)	

Qualification:

No formal education		Non-Matriculate		Matriculate	
Graduate		Post-graduate		Others (specify)	

Job Experience:

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened:

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(continued)

Activity/Works that was continuing during incident/accident:

Excavation		Demolition		Concrete carrying	
Concreting pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0 mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Others (specify)	

What exactly the victim was doing just before the incident/accident ?

.....

Particular of tools & tackles being used and condition of the same after incident/accident:

.....

Description of incident/accident (how the incident was caused):

.....

Nature of Injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Others (specify)			

Parts of body involved in incident/accident:

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Trunk (Abdomen/Back/Chest/Shoulder)		Throat	



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Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Others (specify)	

(continued)

Accident type:

Struck against		Struck by		Fall from elevation	
Fall on same level		Caught in		Caught under	
Caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./Extremes)		Contact with chemicals or oils		Vehicle accident	
Others (specify)					

Name & Designation of person who provided First-Aid to the victim:

Name & Telephone number of Hospital where the victim was treated:

Mode of transport used for transporting victim – Ambulance/Private car/Tempo/Truck/Others:

How much time taken to shift the injured person to Hospital:

In case of FATAL incident, indicate clearly the BOCW Registration No. of the Victim/Company:

Comments of Medical Practitioner, who treated/attended the victim/injured (attached/described here):

What actions are taken for investigation of the incident, please indicate clearly – (Video film/Photography/Measurements taken etc:)

Immediate cause (Please tick the right applicable):

Hazardous methods or procedures inadequately guarded		Poor housekeeping		Inadequate or improper PPE	
Environmental hazards (excess noise/space constraint/inadequate ventilation)		Improper illumination/moving on oval surface		Working on dangerous equipment	
Failure to secure		Horse-play		Failure to use PPE	
Inattention to surroundings		Improper use of hands & body parts		By-passing safety devices	



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Unsafe mixing or placement of tools & tackles		By-passing standard procedures		Failure in communication	
Operating without authority		Improper use of equipment or tools & tackles		Drug or alcoholic influence	
Excessive haste		Others (specify)			

(continued)

Basic cause:

Over confidence		Impulsiveness		Over exertion	
Faulty Judgment or poor understanding		Failing to keep attention constantly		Nervousness & fear	
Fatigue		Defective vision		Ill health or sickness	
Slow reaction		Others (specify)			

Root cause:

Inadequate Engg		Improper Design		Inadequate planning & organization	
Inadequate knowledge		Inadequate skill		Inadequate training	
Inadequate supervision		Improper work procedure		Inadequate compliance with standard	
Substandard performance		Inadequate maintenance		Improper inspection	
Others (specify)					

Loss of man days and impact on site works, (if any):

Remarks from Contractor(s) Safety Officer/Engineer:

- Was the victim performing relevant tasks for which he was engaged/employed ? .. Yes / No
- Was the Supervisor present on work-site during the incident .. Yes / No
- Have the causes of incident rightly identified ? .. Yes / No

Cause of Accident was

Remedial measures recommended by **Safety Officer of Contractor** for avoiding similar incident in future:

Intimation to local authorities (District Collector/Local Police Station/ESI authority): Yes / No / NA. If Yes, to whom



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Safety Officer
(Signature and Name)
Stamp of Contractor

Site Head/Resident Construction Manager
(Signature and Name)

To:
Owner
RCM/Site-in-Charge DASTUR (3 copies)
Divisional Head (Construction) through RCM
Project Manager, DASTUR, through RCM



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**NEAR MISS INCIDENT/DANGEROUS OCCURRENCE SUGGESTED
PROFORMA (To be submitted within 24 hours)**

- **Near Miss:** Human injury escaped and no damage to property, equipment or interruption to work.
- **Dangerous Occurrence:** Damage to property, equipment or interruption of work, but not resulting in personal injury/illness, e.g. fire incident, collapse of structure, crane failure, etc.

Report No.:

Name of Site: Date:

Name of Work: Contractor:

Incident reported by :

Date & Time of incident :

Location :

Brief description of incident:

Probable cause of incident:

Suggested corrective action:

Steps taken to avoid recurrence: Yes No. ☐ ☐

To: Owner

- RCM/Site-in-Charge DASTUR (3 copies)
- Divisional Head (Construction) through RCM
- Project Manager, DASTUR, through RCM



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MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT

(To be submitted by each Contractor)

Actual work start Date:..... For the Month of:
 Project: Report No.:
 Name of Contractor: Status as on:
 Name of Work: Job No.:

Item	Upto Previous Month	This Month	Cumulative
1. Average no. of Staff & Workmen (average daily headcount, not man days)			
2. Man-hours worked			
3. No. of induction programmes conducted			
4. No. of HSE meetings organized at site			
5. No. of HSE awareness programmes conducted at site			
6. No. of Tool Box Talks conducted			
7. No. of Lost Time Accidents (LTA):			
- Fatal			
- Other LTA			
8. No. of Loss Time Injuries (LTI):			
- Facilities			
- Other LTI			
9. No. of Non-Loss Time Accidents			
10. No. of First Aid Cases			
11. No. of Near Miss Incidents			
12. No. of unsafe acts/practices detected			
13. No. of disciplinary actions taken against staff/workmen			
14. Man-days lost due to accidents			
15. LTA Free man-hours i.e. LTA free man-hours counted from last LTA (enter date:)			
16. Frequency Rate (No. of LTA per 2 lakhs man-hours worked)			
17. Se verity Rate (No. of man-days lost per 2 lakhs man-hours worked)			
18. Loss Time Injury Frequency (No. of LTI per 2 lakhs man-hours worked)			
19. No. of activities for which Job Safety Analysis (JSA) completed			
20. No. of incentives/awards given			
21. No. of occasions on which penalty imposed by DASTUR/Owner			
22. No. of Audits conducted			
23. No. of pending NCs in above Audits			
24. Compensation cases raised with Insurance			
25. Compensation cases resolved and paid to workmen			
26. Whether workmen compensation policy taken		Yes	No
27. Whether workmen compensation policy is valid		Yes	No
28. Whether workmen registered under ESI Act, as applicable		Yes	No
Remarks, if any:			

Date:

Prepared by Safety Officer
(Signature and Name)

Approved by Site Head/Resident Construction Manager
(Signature and Name)

To: - Owner
- RCM DASTUR (2 copies)



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DAILY SAFETY CHECKLIST

(To make use of before start of day's work)

Project : Sr. No. :

Name of the work : Date :

Name of contractor : Job No. :

Description of Job decided to perform:

● **Use of PPE/Safety Gadgets**

Sl. No.	PPEs	Compliance (Yes/No)	Sl. No.	PPEs	Compliance (Yes/No)
1	Safety Helmets		6	Face Shield	
2	Safety Shoes		7	Full body harness	
3	Hand Gloves		8	Fall Arrest System	
4	Dust Musk		9	Safety Net	
5	Safety Goggles		10	Horizontal life-line made of steel wire (dia not less than 8.0 mm)	

(Sl. No. 1 & 2 are compulsory for everyone. Specify and ensure use of other safety gadgets as required for the job).

● **Identify following important unsafe conditions:**

Sl. No.	Conditions	Yes/No
1	Access to work site/emergency escape clear	
2	Soil/Loose earth kept away from excavated pit/slope/ladder provided	
3	Electrical wire/welding lead lying entangled on ground/welding m/c. booth accessible	
4	Elevated Work platform/open ends are protected	
5	Ground area cordoned-off before lifting works ore erection at height/ground area checked and cordoned-off before start of height works	
6	Structural members/erected pipes/wooden boards/pieces etc are safely anchored at heights and are not likely to fall down on people when working beneath	
7	Rope ladders tied-up on tall steel structures, long before are removed to get rid of their use	
8	Any other	

● Indicate actions taken, if status of any of the above items is found No ☐

● Specific Safety Guidelines/Precautions, if any (communicated through TBT)

● Above conditions and PPE compliances are checked by undersigned and correct status are indicated after verification.



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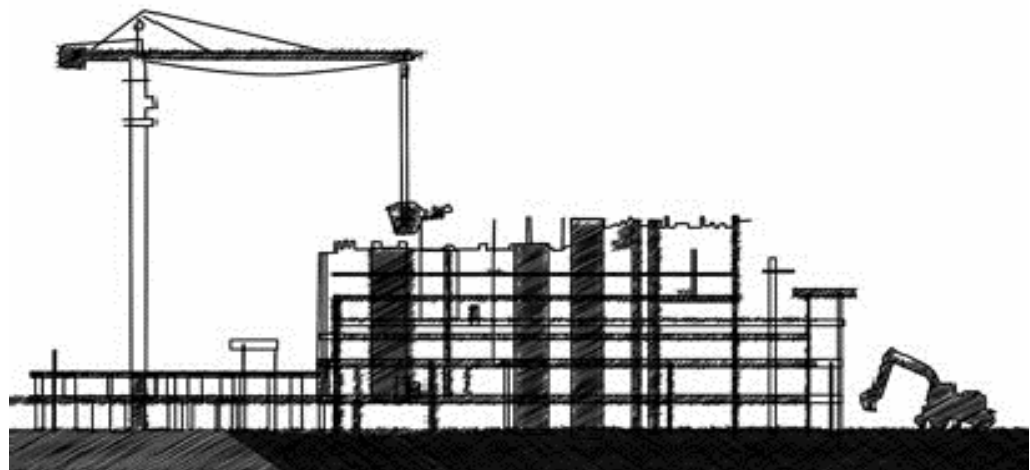
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**HSEP14**

Health, Safety & Environment Plan for Site Operations by Subcontractors



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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:

- Responsibility of operation of above facilities shall rest with BHEL
- Operating cost of the above shall be deducted from subcontractors on 'proportional to contract' value basis. Sample deduction table enclosed as Annexure A.1
- "Contract value" defined above & subsequently in the document shall be considered as "Awarded contract value".
- No overhead cost/ enabling cost of BHEL shall be levied on the contractors for common facilities.
- These running costs shall be recovered from all the available subcontractors at site for the complete operational duration of the site
- 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

- Medical Centre
- Safety park with facilities of audio-visual training & vertigo test center.
- No cost shall be deducted from the subcontractors for the structure part only.
- The running cost with basic inputs already mentioned at Point 1 above shall be shared by all contractors.
- 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.

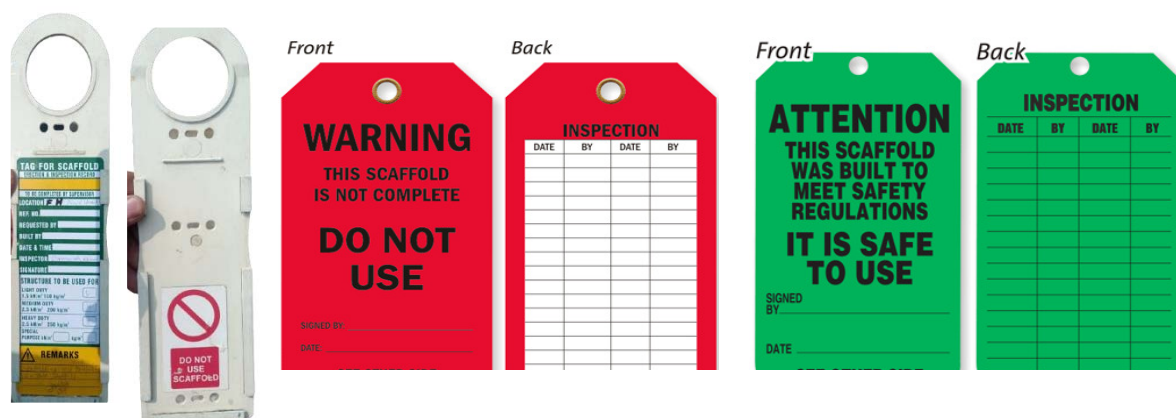


FIG. A.4.1 SAMPLE SCAFFOLD TAGS AND TAG HOLDER

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

- Above requirement is for every shift for each unit.
- 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
- BHEL may modify the deployment plan based on nature and volume of jobs, Risks and hazards associated etc.
- 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.
- For Site Material Management/ Handling (Loading/ Unloading) contracts, 1 no. HSE Officer shall be required irrespective of the total manpower deployed.
- 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.

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

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

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

- 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

- The monthly running Bills of the subcontractor shall be released subject to compliance to HSE requirements as per checklist in Annexure H
- BHEL site HSE Head and Package In-charge shall be authorized to issue the clearance
- Site Construction Manager of BHEL shall be the final authority on the matter.

11. HSE PERFORMANCE EVALUATION

- Subcontractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
- The HSE evaluation shall be based on HSE Performance Evaluation System of BHEL covering the contractual, statutory and regulatory requirements of HSE.
- BHEL shall reserve the right to use these performance scores for evaluating bidder's capacity for future tenders
- 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

- 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.
- As per contractual provision HSE penalties shall be imposed on subcontractors for non-compliance on HSE requirement as per following format.
- 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)
representative)

(BHEL

Signature

Name

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

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

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

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	-	DLCBH	-	*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, DLFH: 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

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- 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.

SAFETY INDUCTED	
Name :	
Date :	
Sign By Trainer :	

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:

- Subcontractor shall prepare a training plan/ matrix covering all hazards and implement the same after approval of BHEL.
- It is to be ensured that every worker undergoes Job-Specific training once every 3 months.
- Records of training programmes along with attendance shall be maintained by the subcontractor
- Each worker to be issued a Card indicating the types of trainings undergone.

11.4 HSE TOOL-BOX TALK:

- 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:
 - Details of the job being intended for immediate execution.
 - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
 - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
 - Recent non-compliances observed.
 - Appreciation of good work done by any person.
 - Any doubt clearing session at the end.
- Tool box talk to be conducted before start of work in every shift.
- 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.
- Record of Tool box talk shall be maintained as per provided **format**

11.5 TRAINING ON HEIGHT WORK:

- Training on height work shall be imparted to all workers working at height by in-house/external faculty at least once every 3 months.
- For Height Workers Separate pass shall be provided by the subcontractor.
- 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.
- The training shall include following topics:
 - Proper use of PPEs – safety harness, lanyard, fall arrester, retractable fall arrester, life line, safety nets etc.
 - 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

- The reference OCPs shall be suitably modified by subcontractor as per specific requirements to control the hazards.
- 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:

- The following activities shall be carried out by the subcontractor strictly after obtaining Permit to Work from BHEL
 - Height working
 - Hot working
 - Confined space Work
 - Excavation more than 2-meter depth
 - Radiography
 - Heavy / Complex / Critical Lifting Activity
 - Night / Holiday Work
 - Material Loading / Unloading
 - Grating, Safety Net, Safety Facility Removal
 - Live Electrical Maintenance etc. - Lockout / Tagout
 - Beam / truss/ duct/ structure alignment
- The Work Permit Formats shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability
- 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).
- 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.
- 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

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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:

- work to be halted in the area
- non-conformance to be generated and submitted to responsible person and BHEL
- 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:

$$\text{Number of Reportable LTI} \times 1,000,000 / \text{Total Man Hours Worked}$$

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:

$$\text{Days lost due to LTI} \times 1,000,000 / \text{Total Man Hours Worked}$$

13. Incidence Rate:

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\text{Number of LTI} \times 1000 / \text{Average number of manpower deployed}$$

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

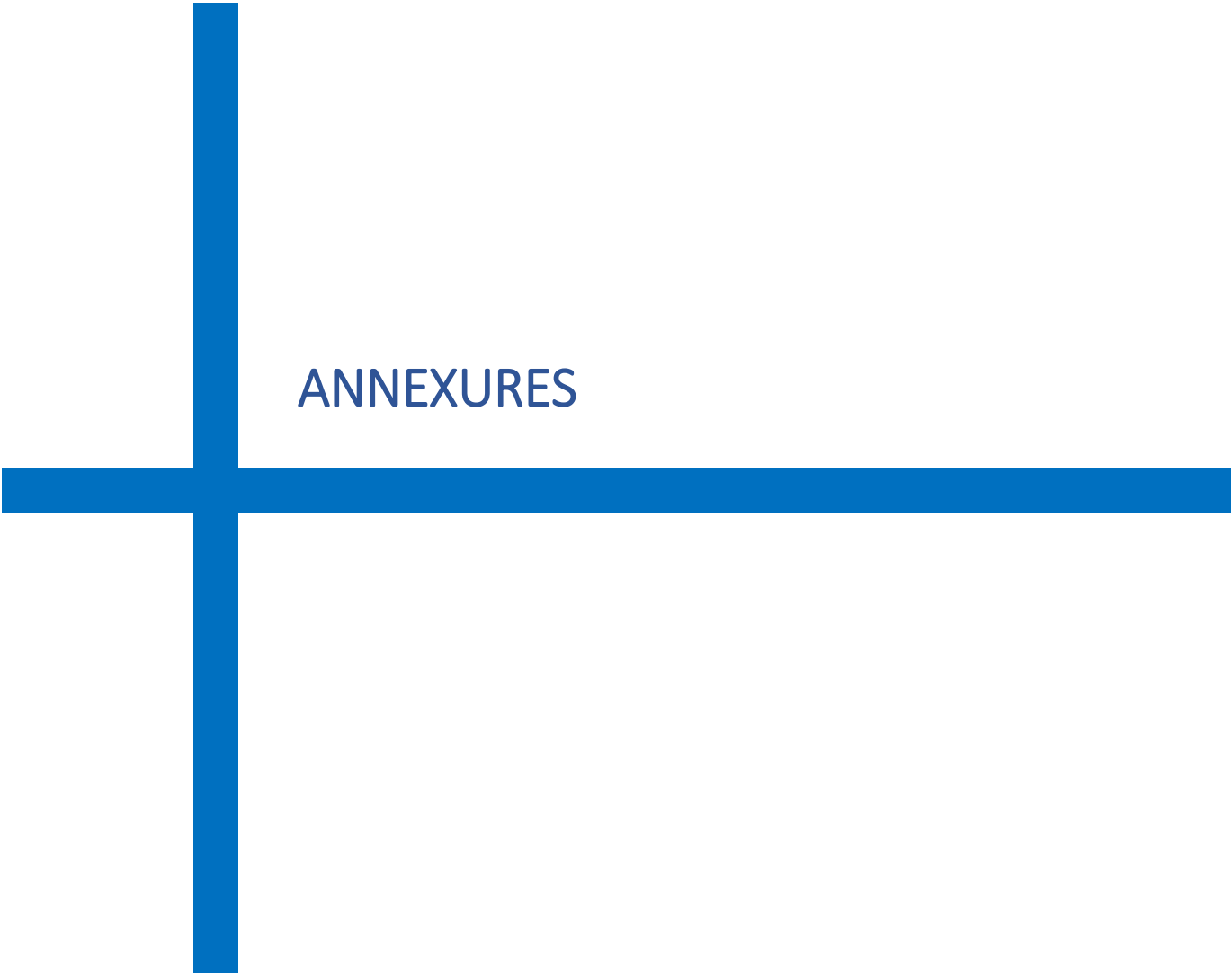
19. Safety Committee:

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.

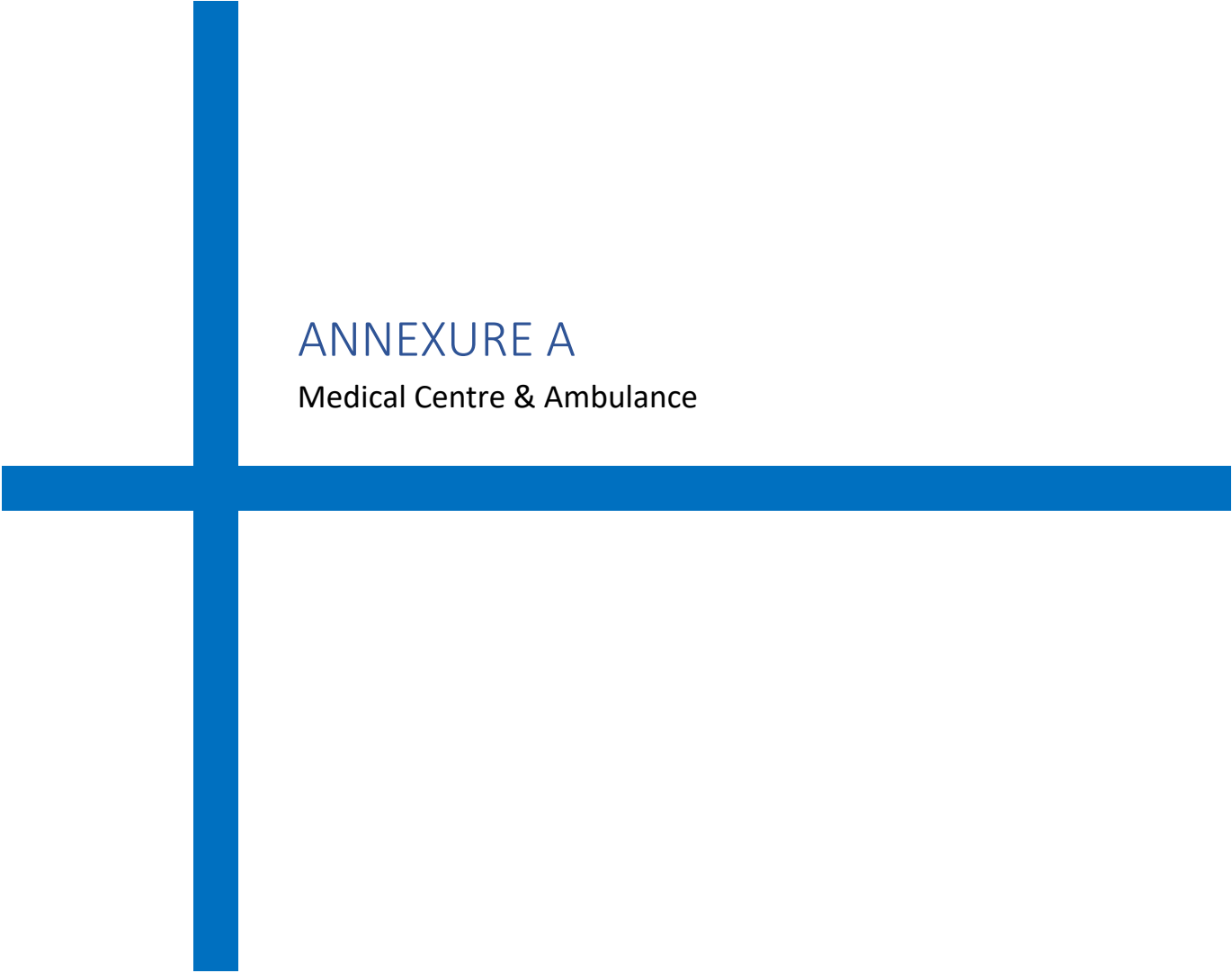
20. Night Work:

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.
- xlvi. Adequate number of sterilised, paired, latex hand gloves.

B. Ambulance

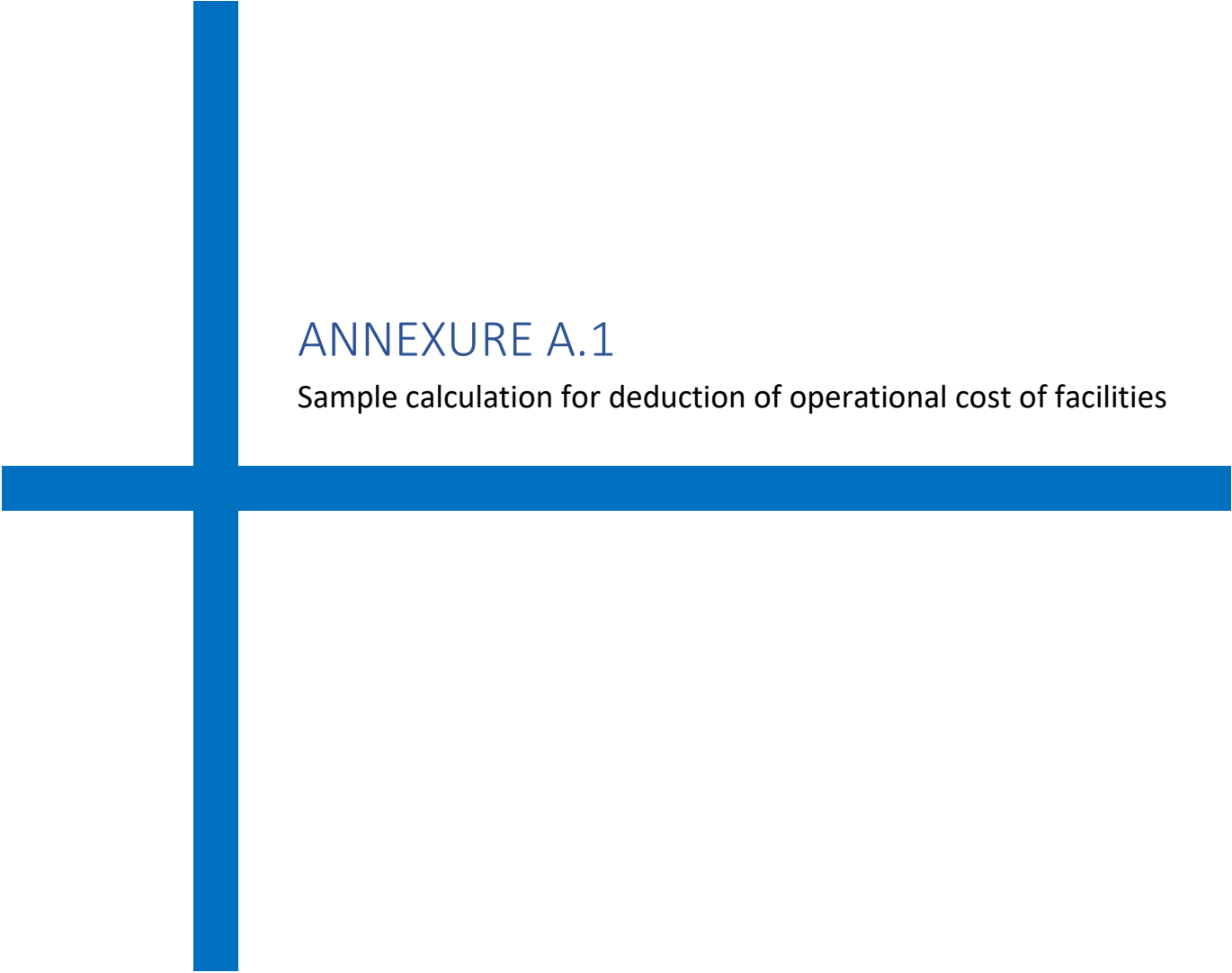
1. When number of workers is <500:
If the distance to a major hospital capable of handling critical injuries expected at Site is ≤ 50 KM from Site, then 1 BLS (Basic Life Support)/ Type B Ambulance otherwise ALS* (Advanced Life Support)/ Type D Ambulance
2. If no. of workers increases to >2000 workers 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 suppression 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

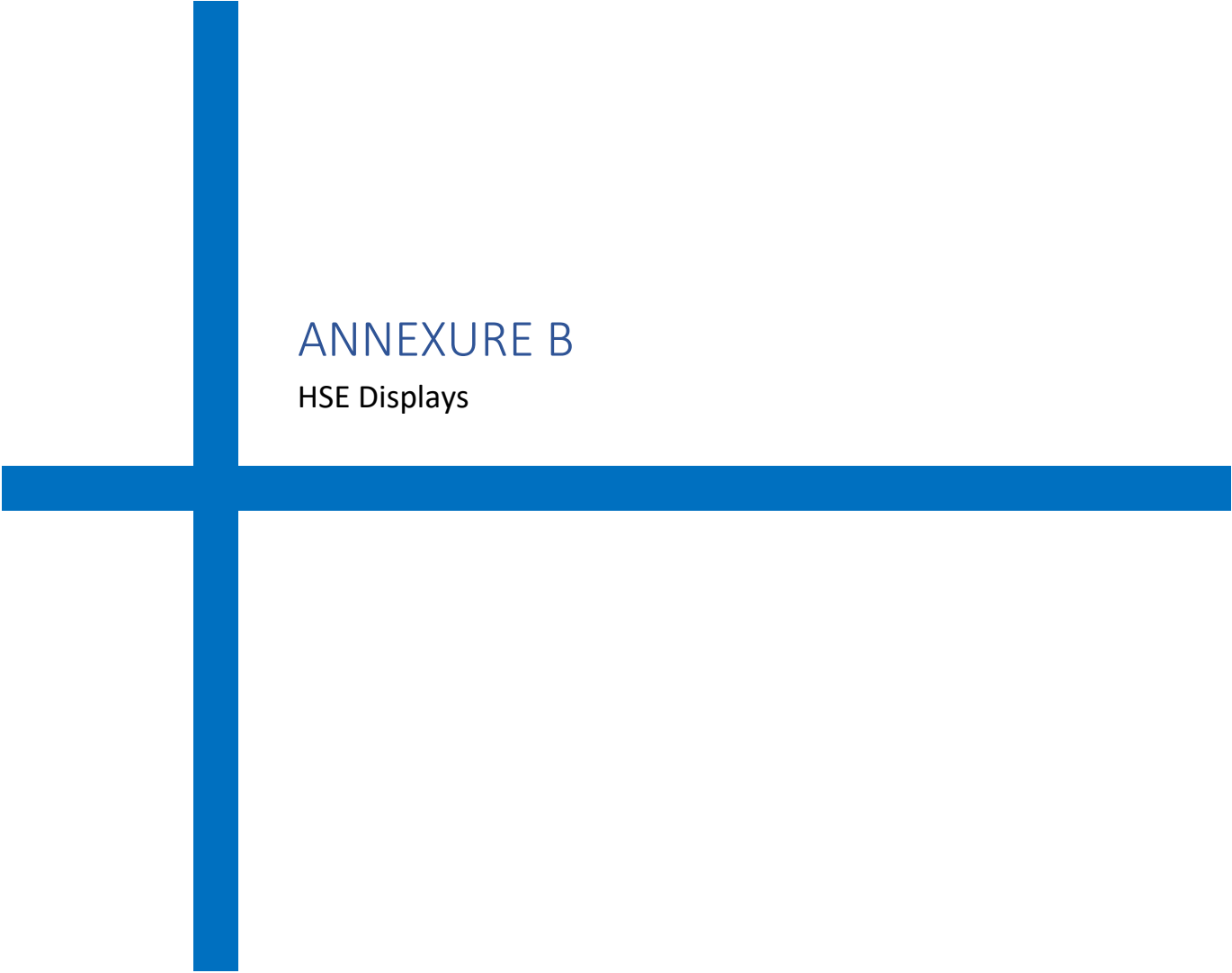
Period (In Months)	6	36	6
	For 1-6 months	For 7-42 months	For 43-48 months
Cost to be incurred from contractors	7%	81%	12%
	1.17% per month	2.25% per month	2.00% per month

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
Month No.	6	8	47	31	9	39	43	34	9	8		
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:

- Displays should be weather-proof as per installation location, i.e. rain-proof, wind-proof and sun-proof.
- Installation location and size to ensure visibility for the intended viewers (workers and moving personnel)
- Displays to have at least 50% graphical elements preferably (as applicable). Language should be understandable by majority of the workers
- Displays to be relevant to the hazards in the area
- Proper installation to ensure boards don't obstruct activities and should not be prone to fall so as to pose danger
- In case of multiple elevations (eg. Boiler, Power-house etc.), each elevation to have displays for applicable hazards including Height-Work, Housekeeping
- For temporary work locations, posters/ boards may be erected and shifted after task is over
- Minimum size of displays should be A1 unless otherwise specified
- In case of damage, displays shall be reviewed and repaired/ replaced
- In areas where night work is envisaged, fluorescent displays shall be installed and these should comprise of at least 20-30% of total displays
- 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

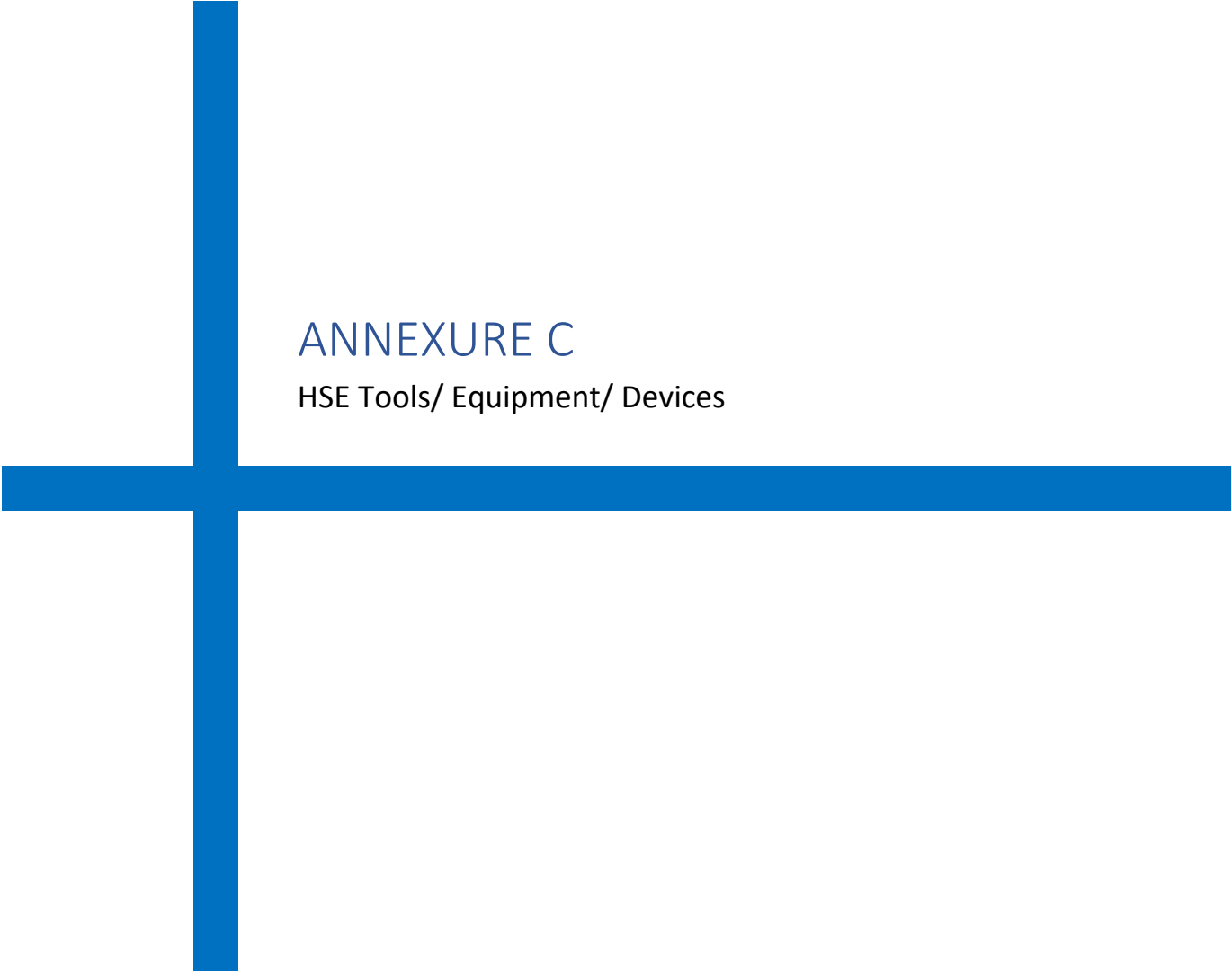
Table 1
(Area/ Package-wise HSE Display Plan – As applicable)

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

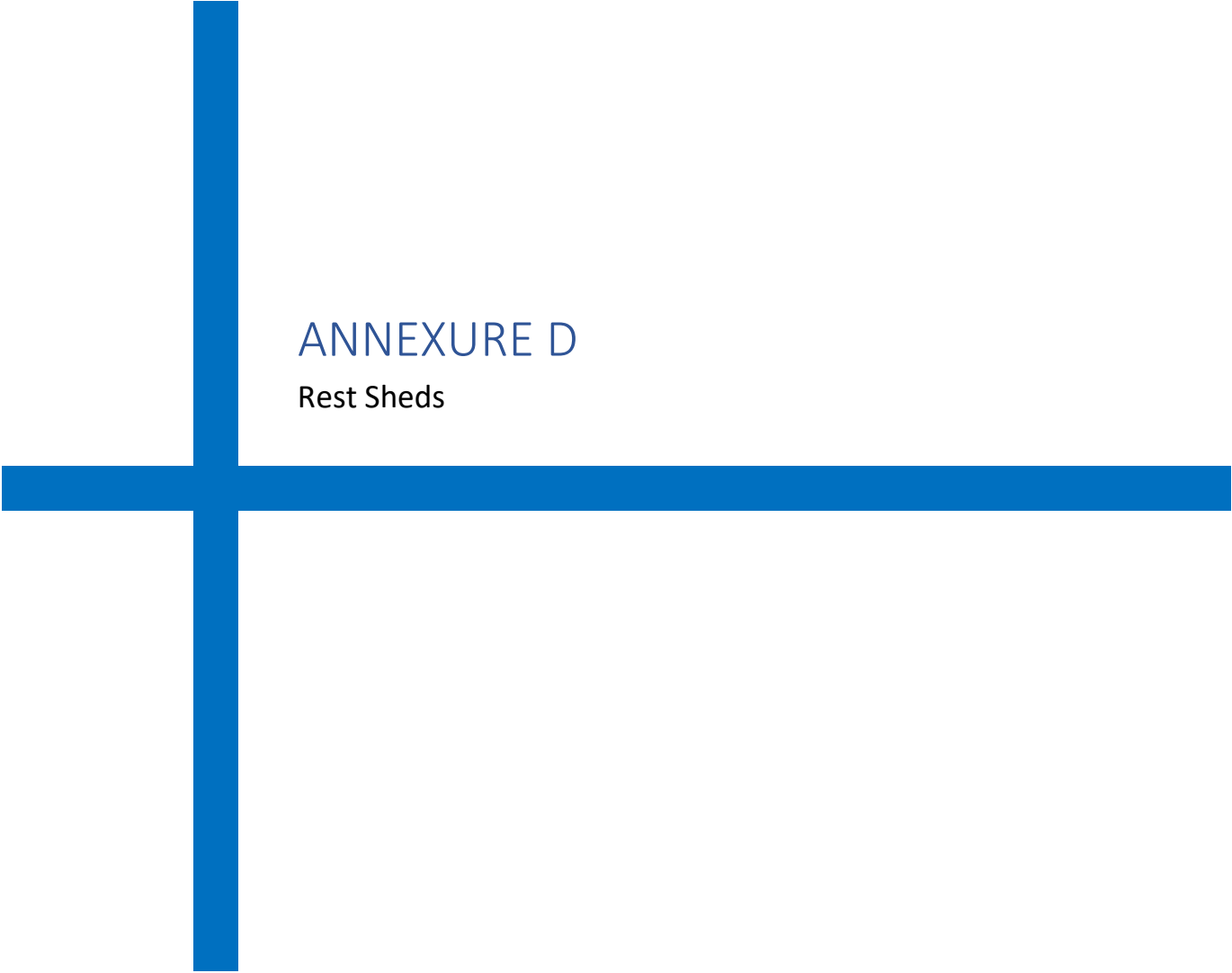
Following equipment conforming to relevant IS/ISO/BS Codes/ Standards in indicated quantities shall be ensured by subcontractor. This list is tentative, not exhaustive. Quantity and date/ period of deployment shall be as per site requirement.

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:

W_{max} = Maximum number of workers at any time in the Site

Space per worker = 1.1 sq meter

Total space required, $T_{space} = W_{max} \times 1.1$

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

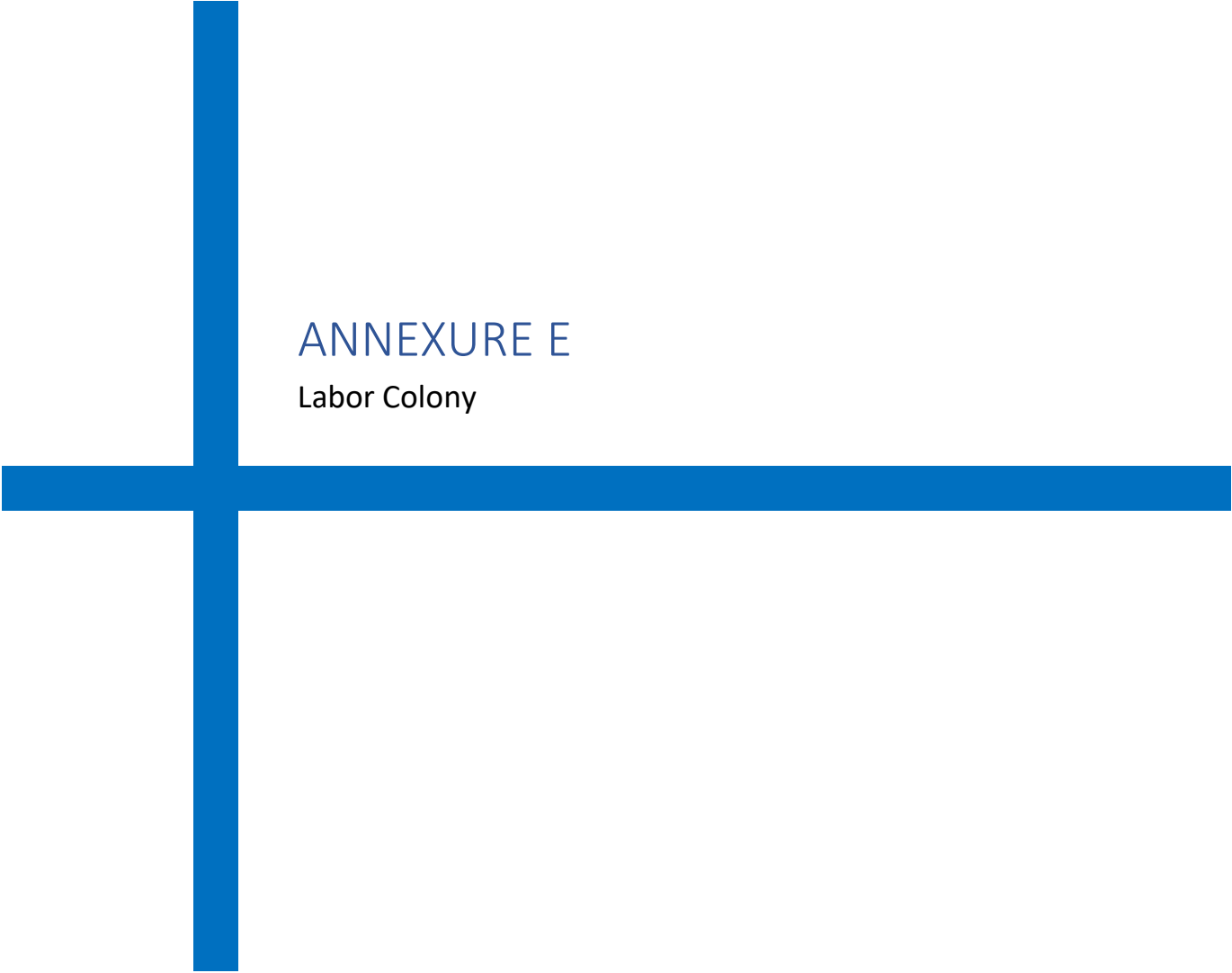
Use of asbestos in construction is banned and shall not be used.

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

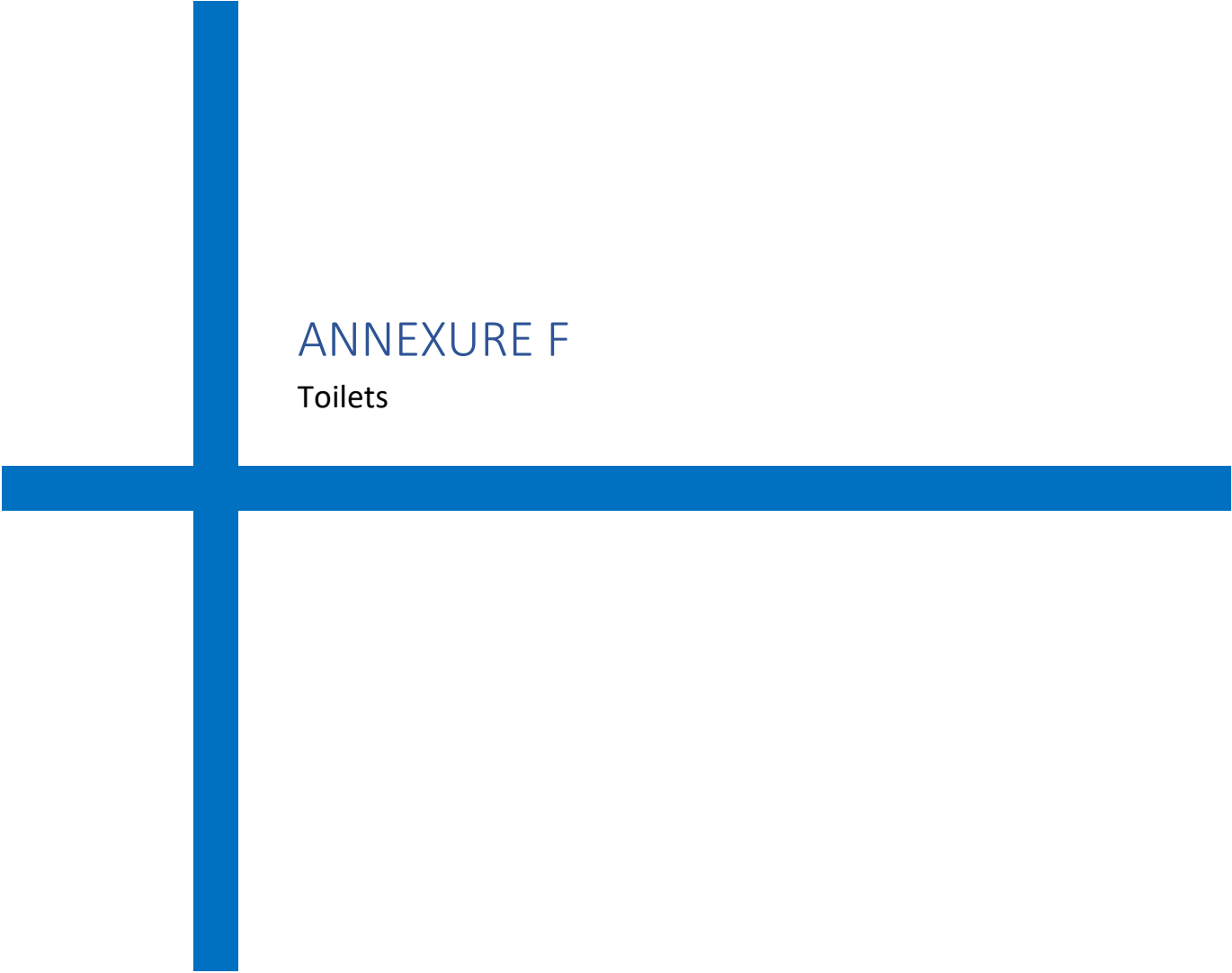
Labor Colony

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

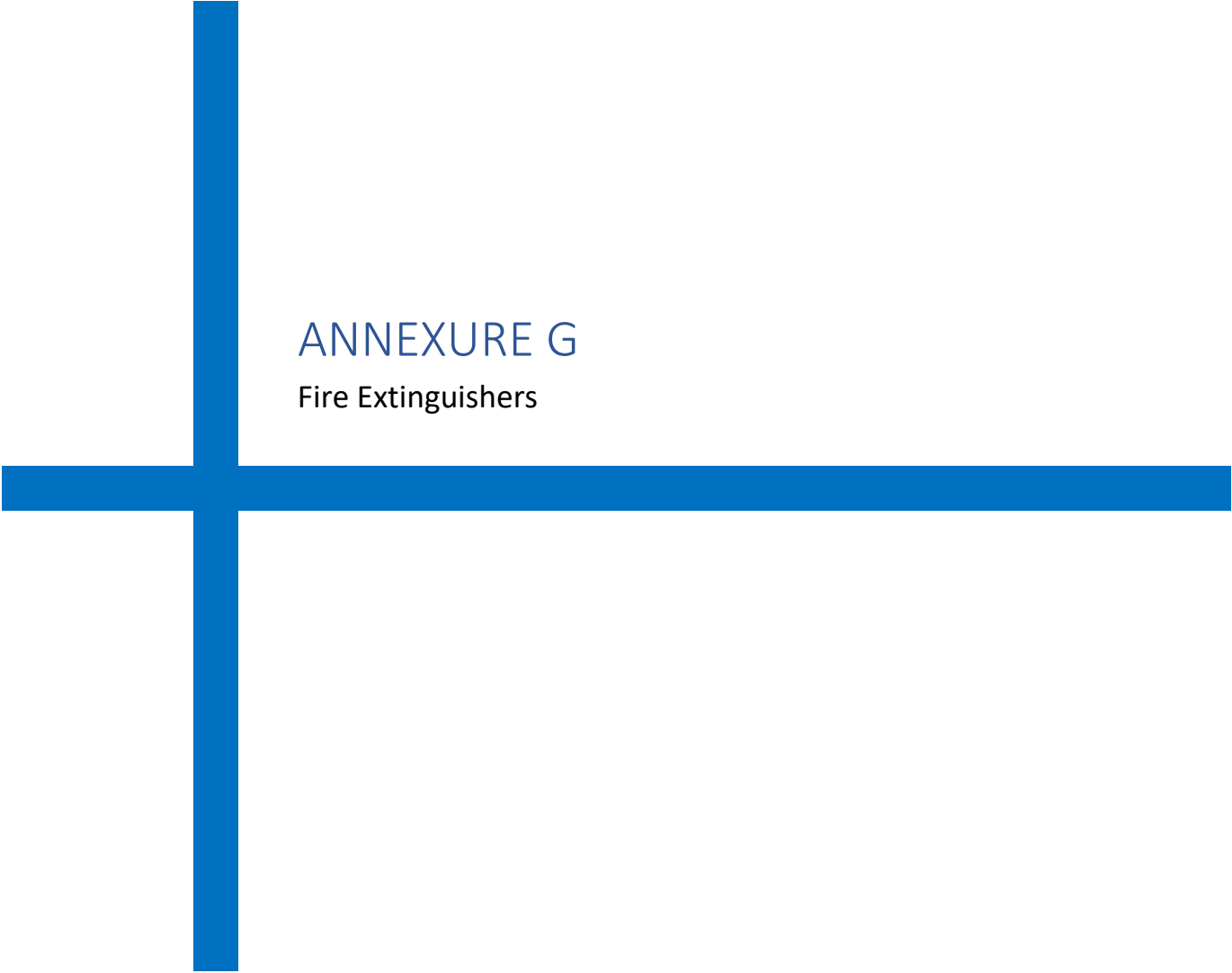
Toilets

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: - - Where females are employed, there shall be at least one latrine for every 25 females; - 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:

- 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 Only**', as the case may be.
- The notice shall also bear the figure of a man or of a woman, as the case may be.
- The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
- The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
- Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the public health authorities.
- Water shall be provided by the means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.
- 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
- 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

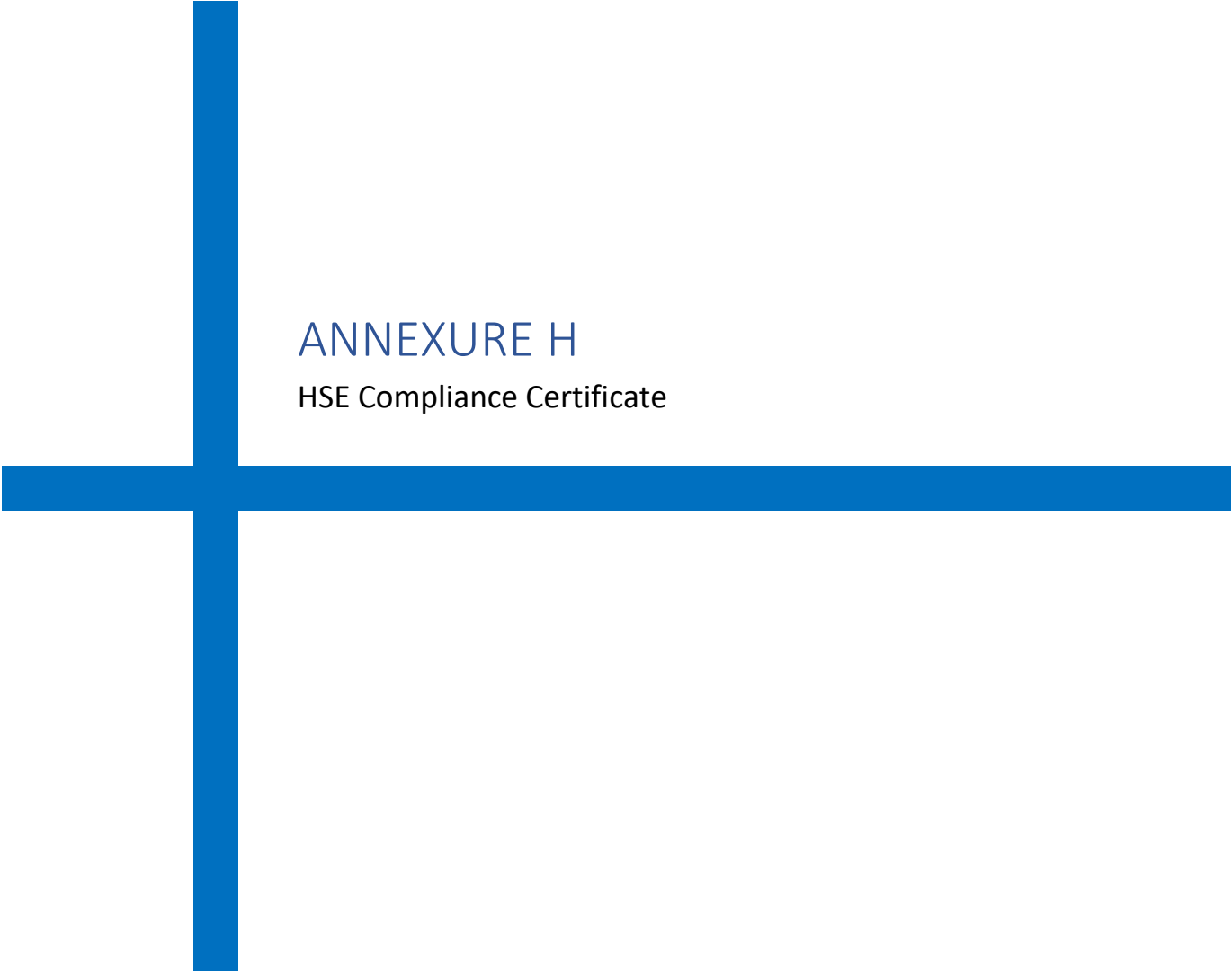
Fire Extinguishers

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. CO ₂ ; 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 CO ₂ ; 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 DRY 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 CO ₂ . 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

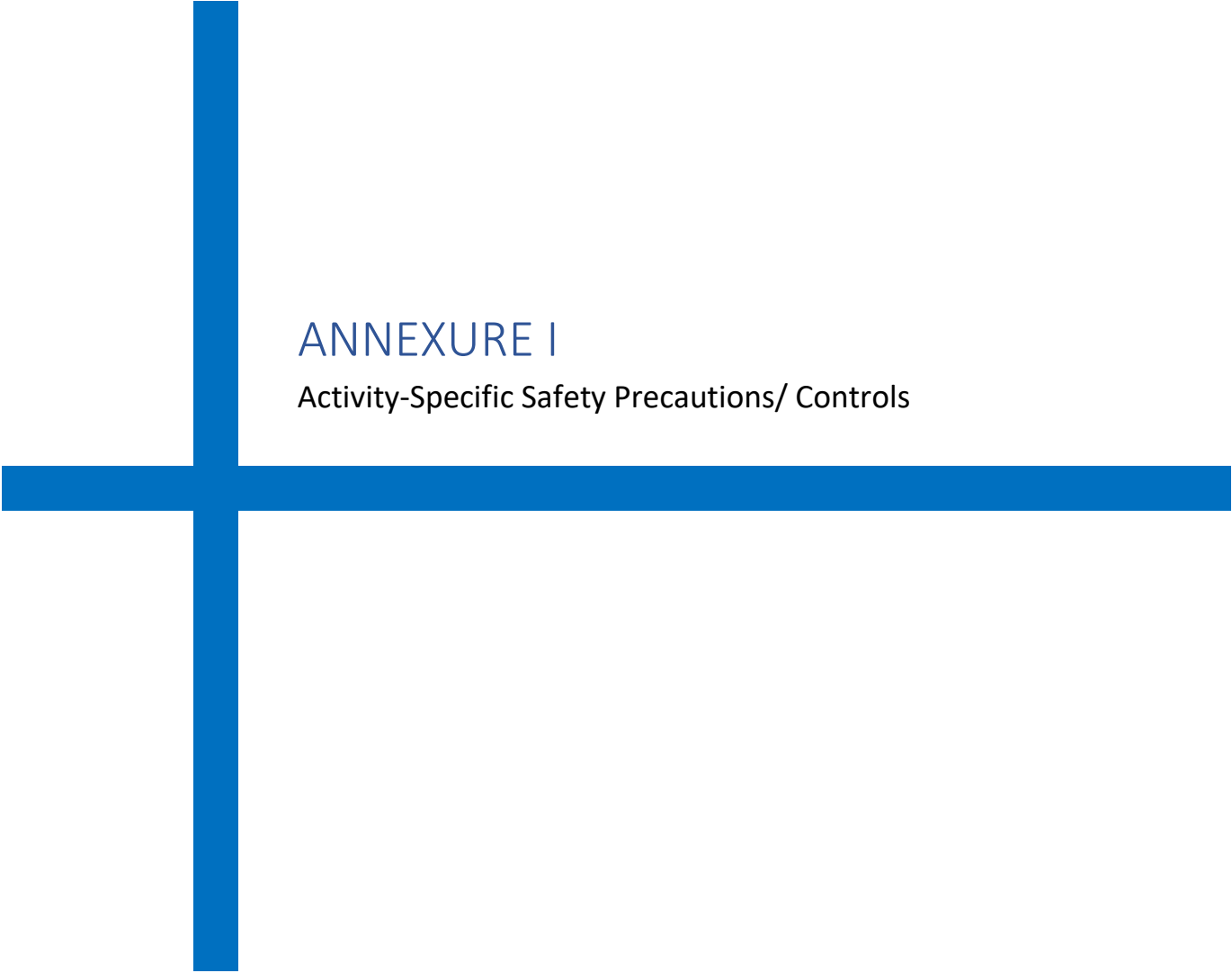
Bill Ref no: _____ Date: _____

NAME OF THE AGENCY: _____ Work-Area/Package: _____

Sl. No.	Description	Remarks
1	<u>HOUSE KEEPING:</u>	
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	<u>GENERAL ILLUMINATION:</u>	
2.1	ALL the working areas at site & office of the agency including passages are having proper & sufficient illumination.	
3	<u>STATUTORY & REGULATORY REQUIREMENT:</u>	
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	<u>SAFETY COMPLIANCE:</u>	
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.	

<u>VENDOR'S SIGNATURE</u>	
Erection Engineer	
HSE Officer	
Site-in-Charge	

<u>BHEL'S SIGNATURE</u>	
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

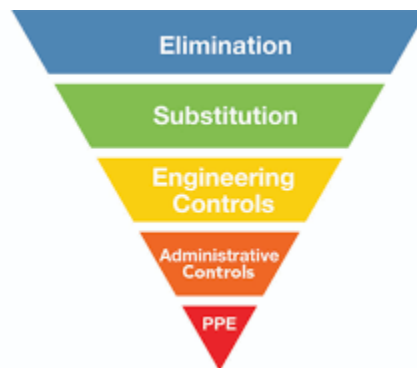


Fig. 1.1

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

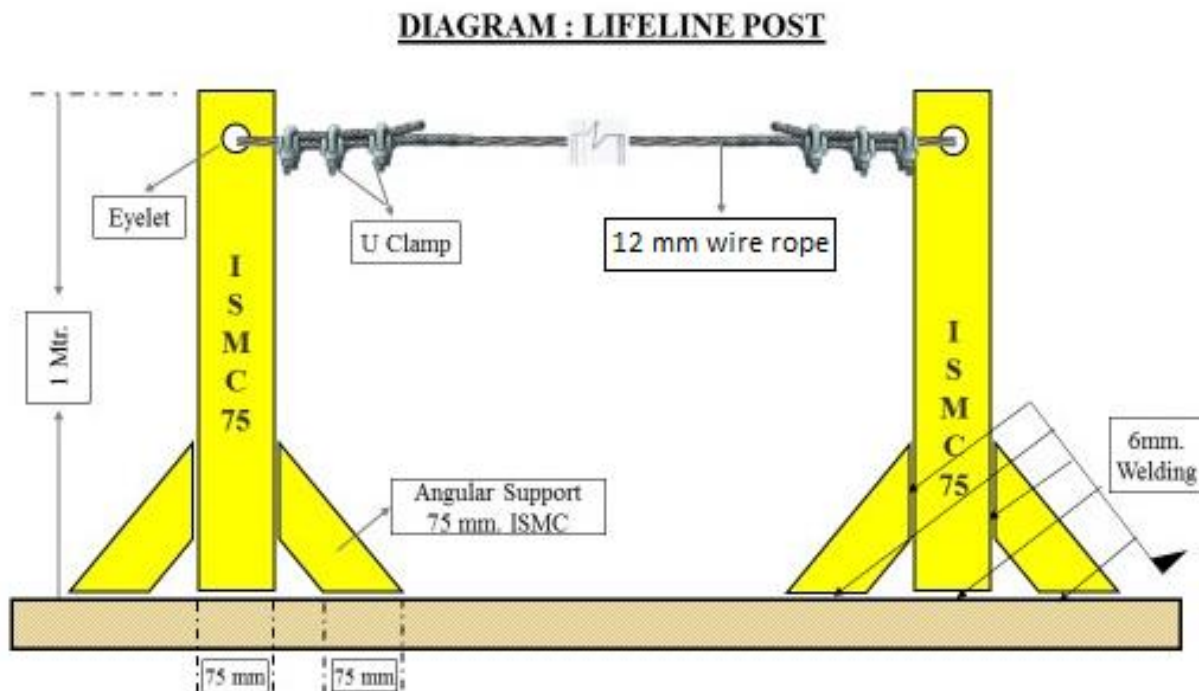


Fig. 2.1 Lifeline Post

- 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. Precautions against the fall of Materials, Persons and Collapse of Structures:

- 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.

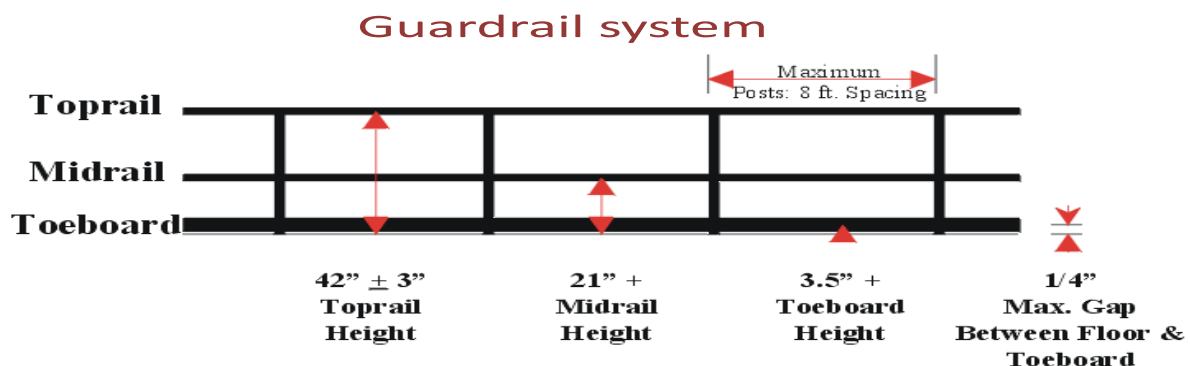


Fig. 2.2 Guard Rail System

- 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.

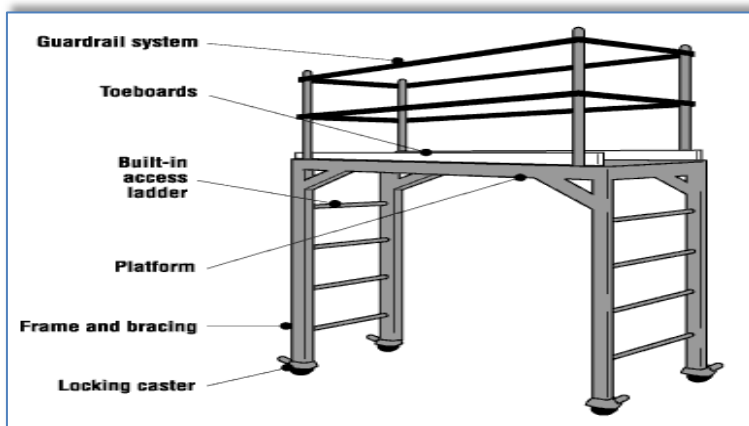
x. Requirements for different types of Scaffolds:

A. Suspended Scaffold

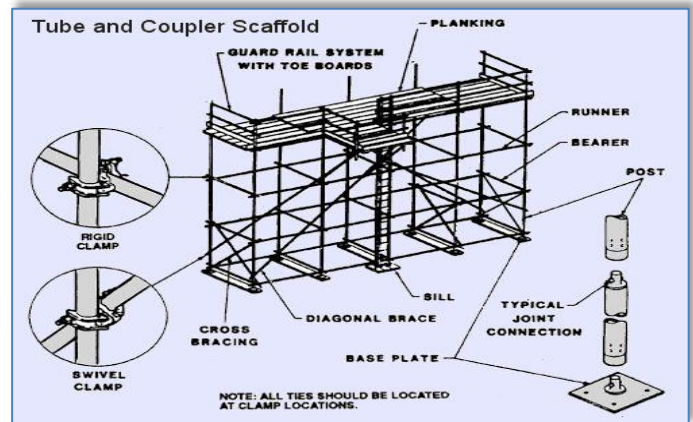
- i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

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, loose or rough soil
- xi. Do not use ladders of conducting material near power lines, and only use ladders near power line or other energized 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 exposure 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 works 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 an 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 required 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	$\frac{3}{4} : 1$	53 deg.
Type B	1 : 1	45 deg.
Type C	$1\frac{1}{2} : 1$	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 signaller /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:**

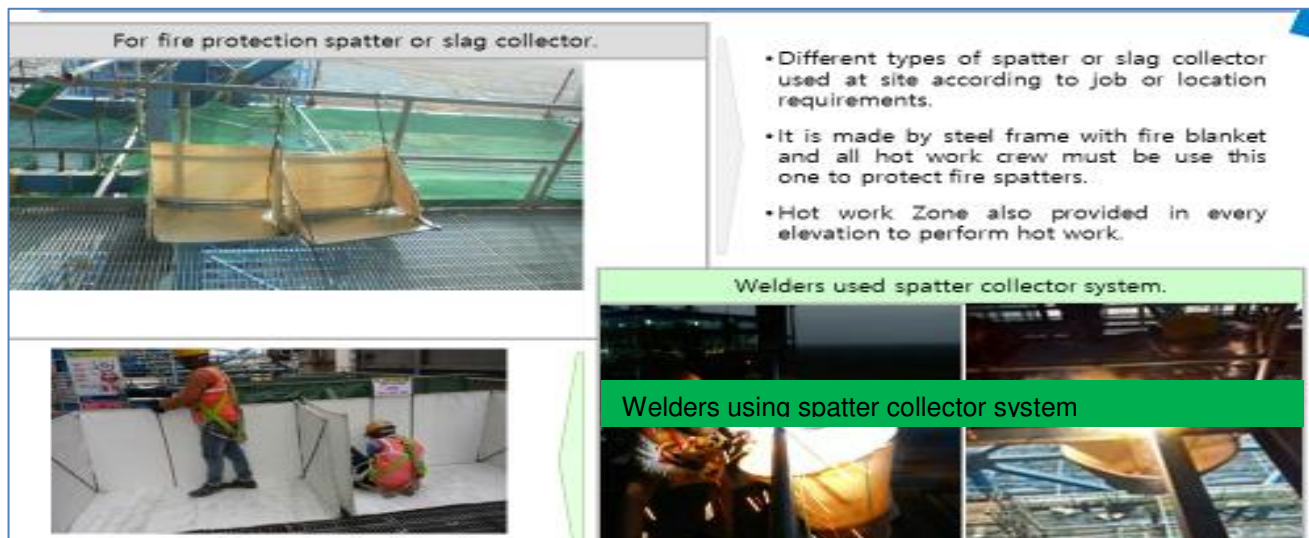


Fig. 4.1 Splatter / Slag Collector

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 shall 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.

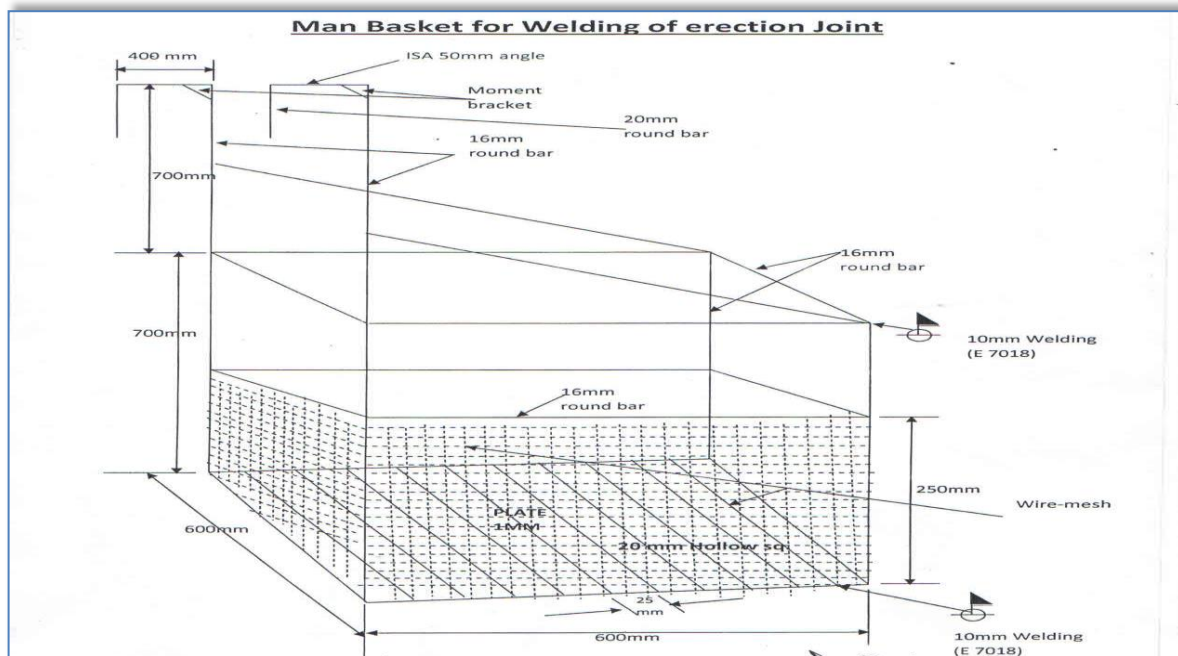


Fig. 5.1 Man Basket for Welding Erection Joint

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.

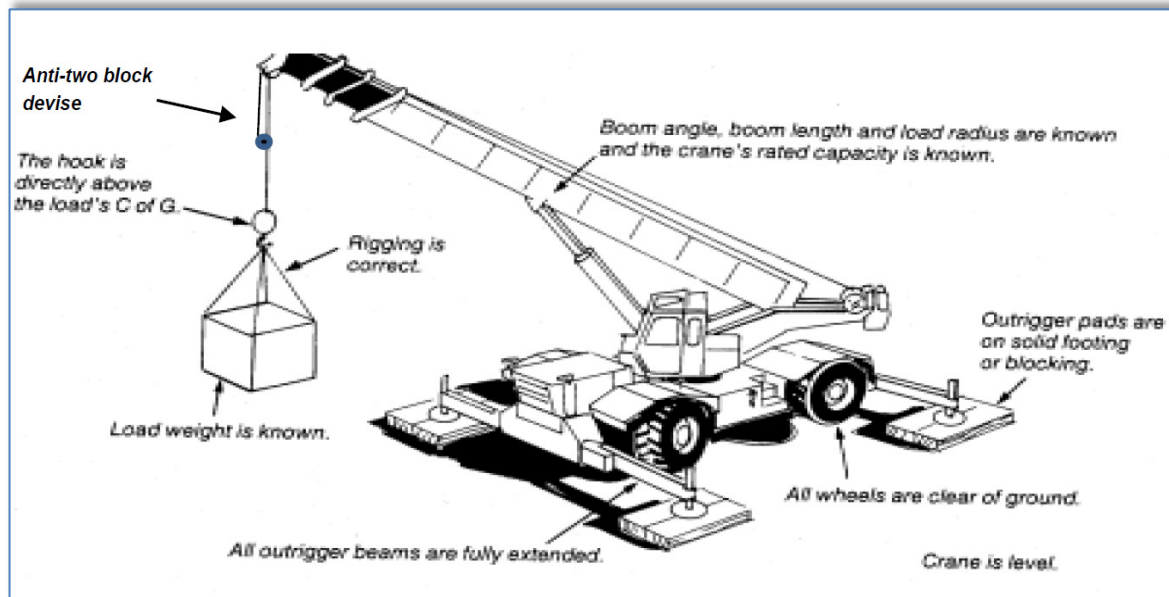


Fig. 5.2 Proper Crane Setup

- 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. Crane operators must follow the following:
 - 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.

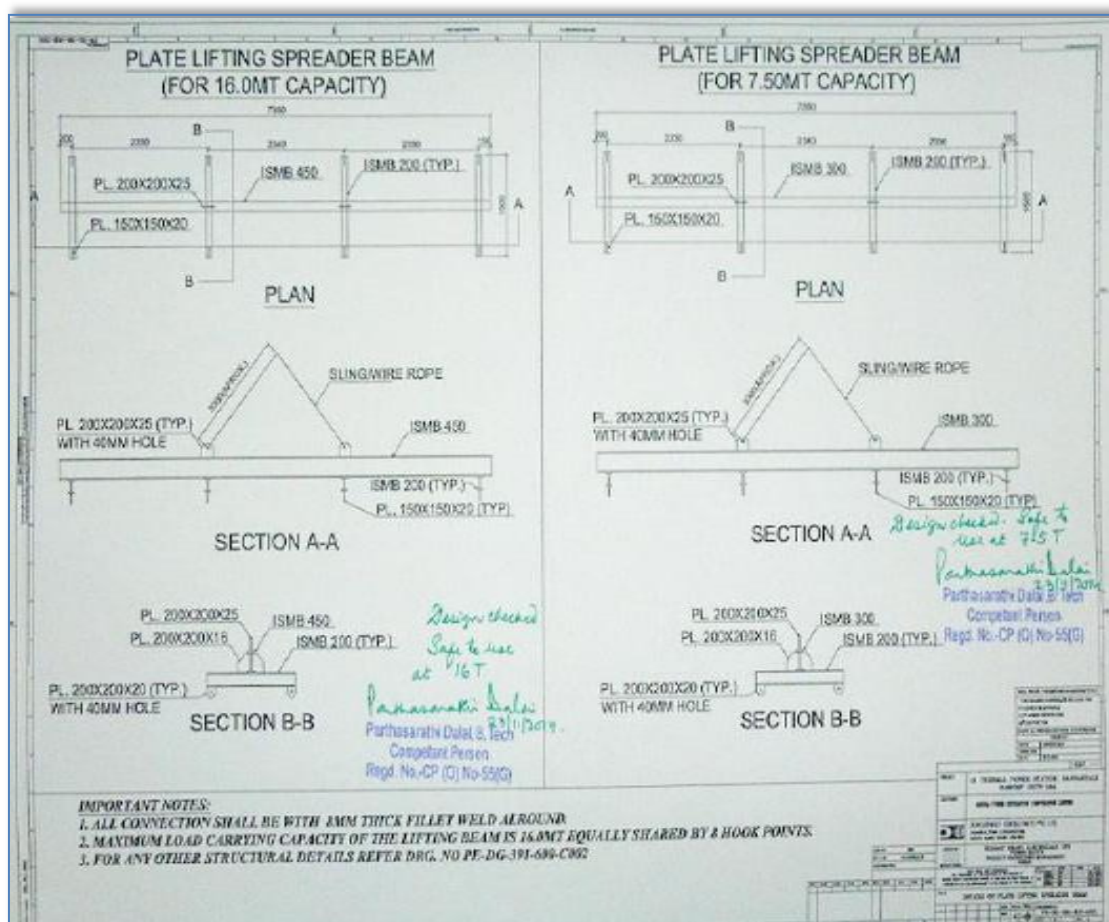


Fig. 5.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads

m. Safe Rigging Practices

- Review the planned operation and requirements with the operator and rigging crew.
- Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
- 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 desired clearance by visual means.
- Clear the lift area of all unnecessary personnel.
- Hydras shall only be allowed for loading & unloading works & shall not be allowed to move with load

n. Rules for Safe Rigging

- Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
- 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.
- Slings must not be pulled from between or under loads with load resting on the sling.
- Keep all rope away from flame cutting or welding operations.
- Never use rope as sling material.
- 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 selecting 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.

Suggested hand signals



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 than armour earthing.

- 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.

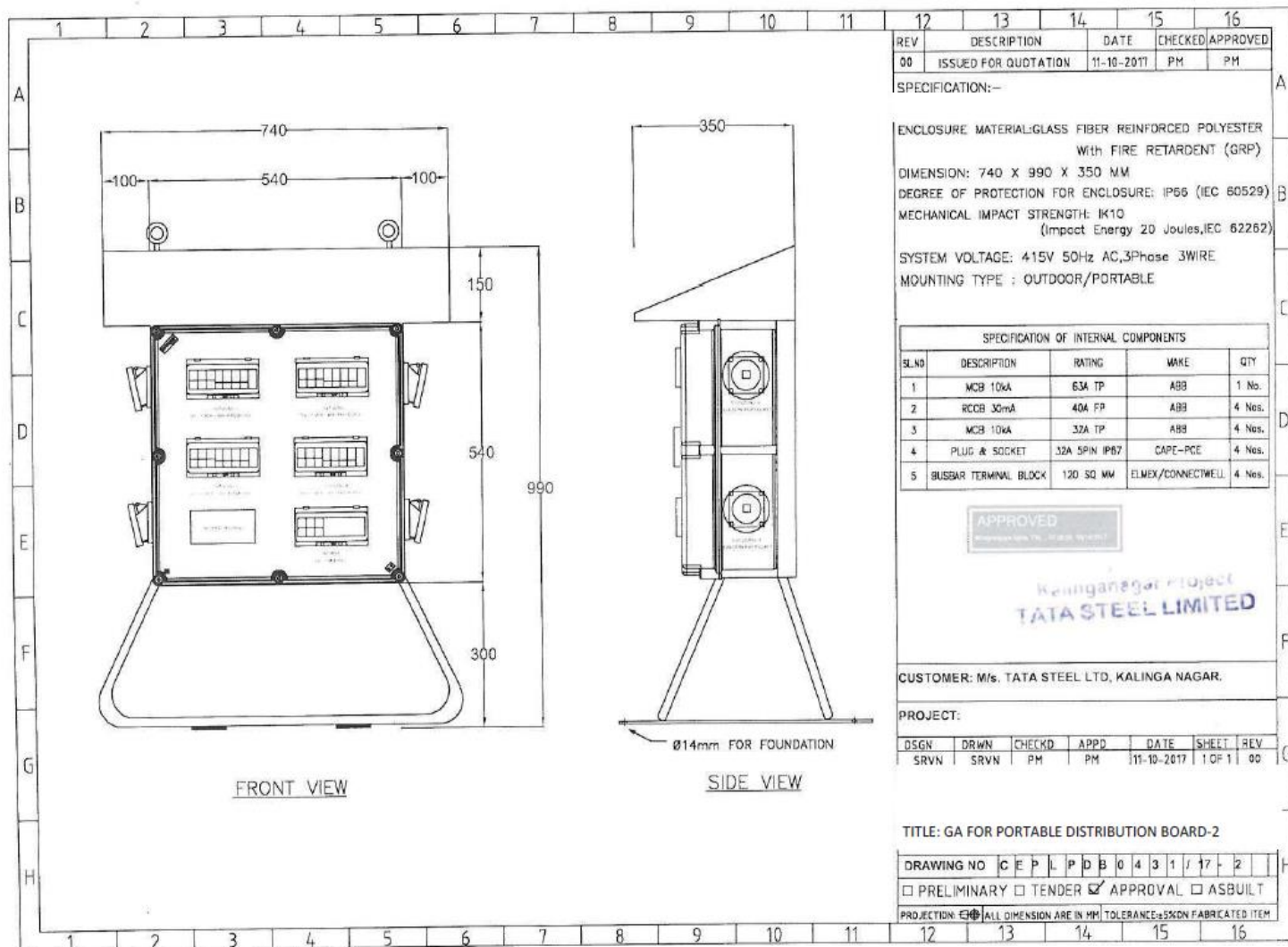


Fig. 9.1 Layout of a modern Power Distribution Board

x. General Electrical Safety

- In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft. to all power lines.
- 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
- 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.
- 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).
- 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 addition 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 painting operations
 - iii. VOC's from painting and coating operation
 - iv. Disposal of paints and coats drums
- c. Control Procedure for Painting:
 - 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 WBPDC (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 Charge is 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 inadvertent 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

		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 / CLOSE D -	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.	Request or 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. Preventive measures at project site:

- 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.

a. Strict Control at the Gate/ Banning Entry to Anyone Not Wearing Masks

- 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.

b. Screening at Gate with Contactless Thermometer & Action on Suspected Cases

- 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

c. During site execution activities:

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
- lii. Surgical spirit-95% alcohol content
- iv. Hand sanitizer should have: Isopropyl alcohol-75%, Glycerol-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

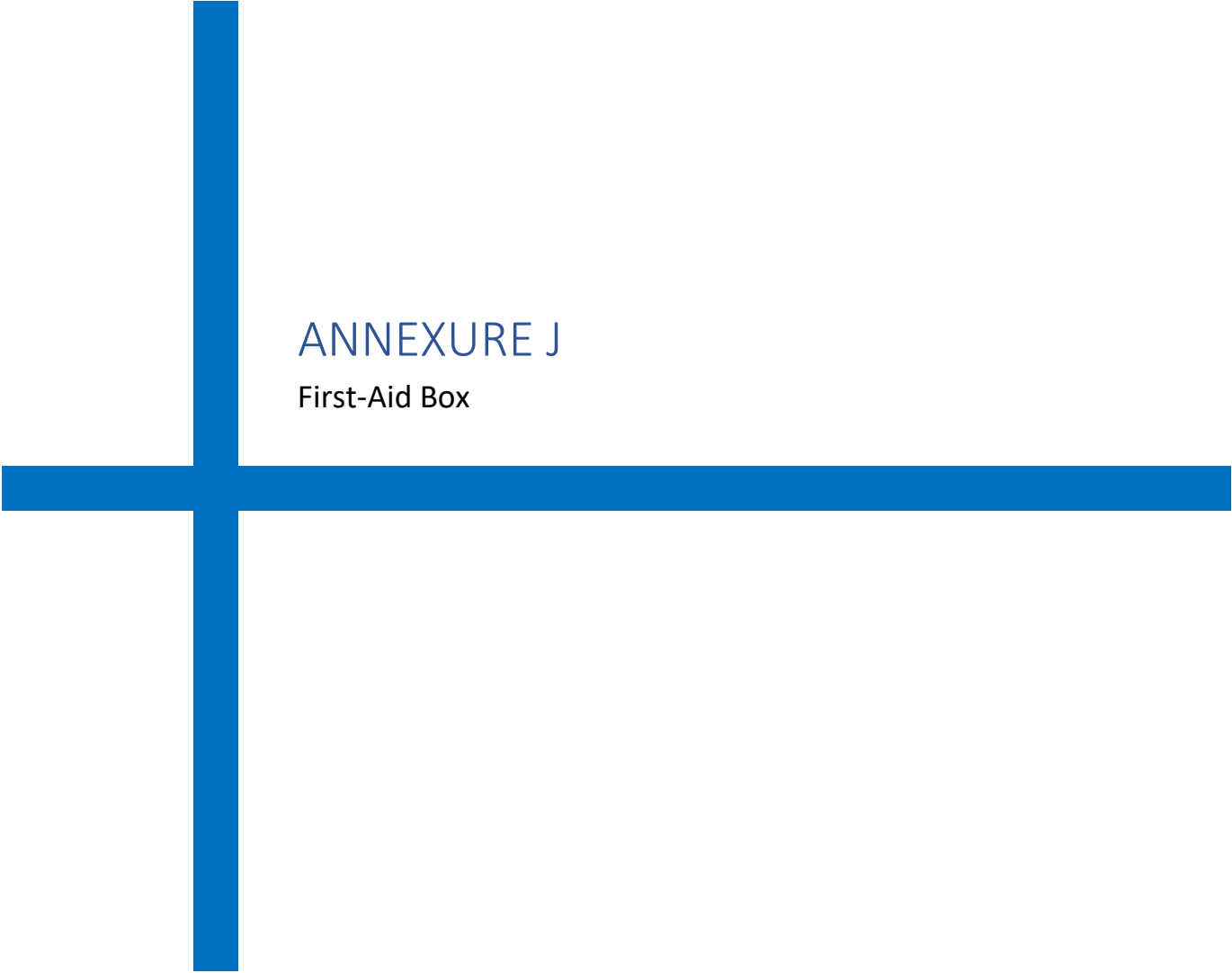
15.5 Noise Mitigation

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:

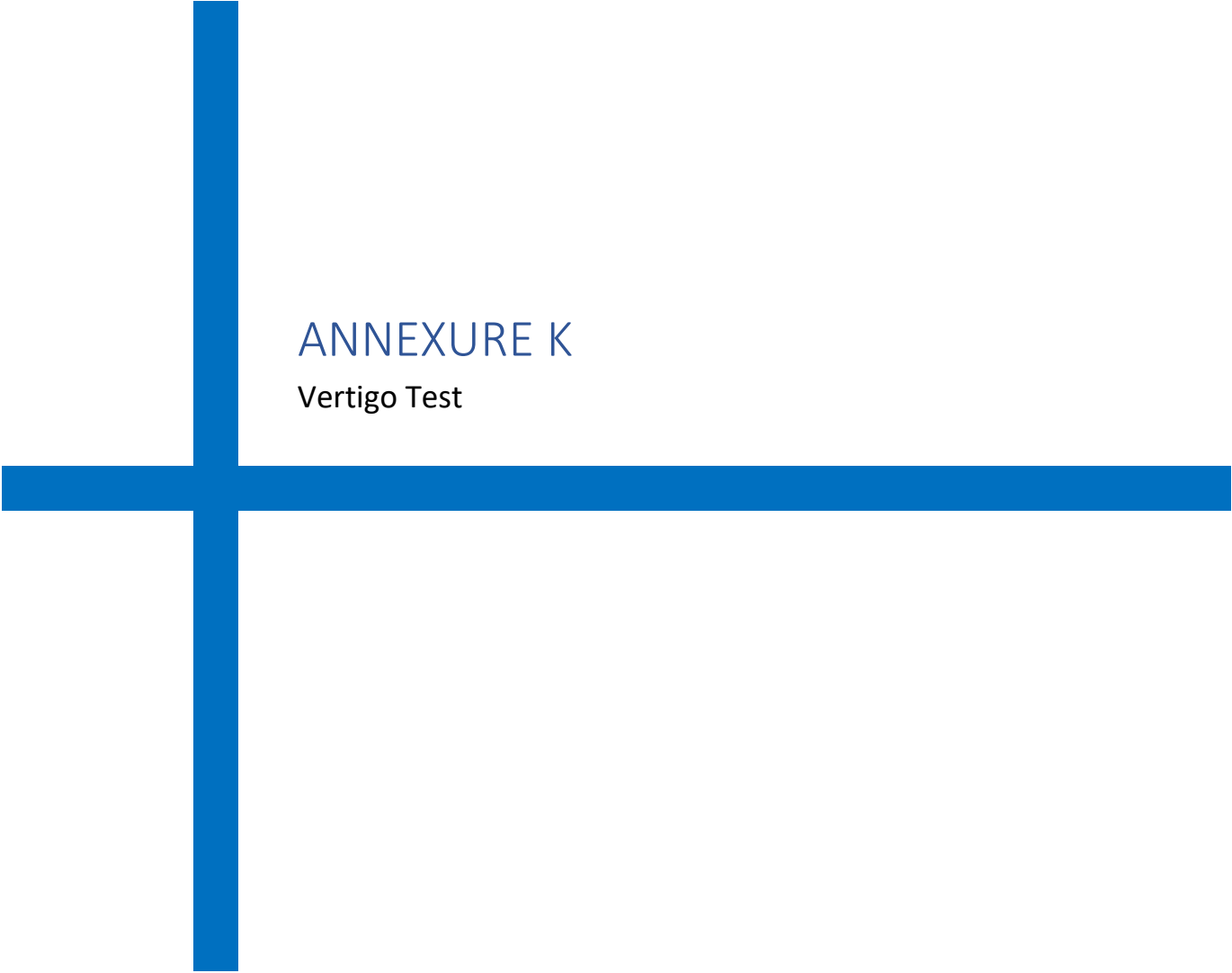
(a) For establishments in which the number of contract labor employed does not exceed fifty, each first aid box shall contain the following equipment:

(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.

Social Accountability 8000 Compliance Format

A. Basic information

Name of the organization		
Address		
Telephone No		
Name of the Proprietor		
Nature of Business		
License Number and date of expiry		
Employees	Staff (Total Number)	Workmen (Total Number)
• Permanent		
• Casual		
• Badli		
• Temporary		
• Contracted		

B. Information regarding Social Accountability

- What is the minimum age required to join your organization?

_____ Years

- What types of certificates (Like mark sheet, birth certificate) you keep with you?

Original Copy / Xerox

- Do you require to keep any kind of deposit inform of cash at the time of employment?

Yes/No

- Do you provide safe & healthy work environment as per statutory requirement?

Yes/No

- If directly not provided by you, do you get health & safety benefits from NALCO?

Yes/No

- Are you certified for SA 8000?
If Yes, please submit a copy of SA8000 Certificate along with this filled up questionnaire

Yes/No

Have you undergone Code of Conduct Audit (COC Audit) in last 2 years ? Yes/No

If yes, please submit a copy of Code of Conduct Audit Report along with this filled up questionnaire

Have your sub-suppliers been certified for SA 8000? Yes/No

Have your sub-suppliers undergone Code of Conduct Audit (COC Audit) in last 2 years? Yes/No

▪ Do you provide personal protective equipment(s) to your employees free of cost? Yes/No

▪ Do you provide safety training to your employees? Yes/No

▪ Do you ensure canteen facility for your employees? Yes/No

▪ If not, do you get the facilities from NALCO Yes/No

▪ What types of medical benefits you provide to your employees?

▪ Do you allow trade union and collective bargaining in your organization? Yes/No

If no, how do you ensure freedom of expression?

▪ Incase of non-performance of any employee, how do you deal with such situations?

▪ What are the procedures of hiring/promotion/ remuneration in your organization?

- Do you provide appointment letter to your employees? Yes/No
- Do you maintain a documented terms and conditions of employment? Yes/No
- Do you maintain a disciplinary procedure? Yes/No
- If no, how do you terminate your employee?

- How do you ensure that your employees are not discrimination on the basis of cast creed, gender, religion, age and dieses?

- How many shift you have? _____ shifts
- What is the official working time? _____ hours
- Which day is off day in your organization? _____
- In case, a person works in off day or holiday, how is he/she compensated?

- Do you pay overtime to your employees as per law? Yes/No
- What is the lowest amount (salary/wage) you pay to your employees? Rs. _____/-
- Is there any case of deduction in wage? Yes/No

- In case, it is yes, what are the general reasons for such deduction?

- Is there any apprentice period in your organization? Yes/No

- If yes, what is the apprentice period in your organization? _____

- Do you have any international certification Yes/No

- If yes, please specify

- Do you receive, handle or promote goods and/or services from supplier/subcontractors or sub-suppliers Yes/No

- Do you receive, handle or promote goods and/or services from supplier/subcontractors or sub-suppliers who are classified as home worker? Yes/No

- If yes, what steps you have taken to ensure that they get similar level of protection as afforded to directly employed employees?

- Have you taken care to look into issues related to child labor Forced labor, health & safety, working hours and remuneration of your suppliers Yes/No

We do hereby declare that our organization is committed to social accountability. We will promptly implement remedial/corrective actions identified against the requirement and promptly inform your organization. We also declare that the sub-contractors/sub supplier's performances are monitored by us. Moreover, we declare that if invited, we shall participate in awareness program as well as monitoring program organized by you.

We declare that the above-mentioned information is correct.

Signature:

Designation:

Date

Seal of the organization

T&P HIRE CHARGES

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)
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)	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

**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

**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

**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 (Ungraded 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

**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

**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 DIAGNOSTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3230
59	PMI Machine OLYMPUS make	3350
60	Móbile 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

**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

**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	ELECTRIC WINCH 5T	1410
6	ELECTRIC 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 FILTRATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	7070
3	-DO-, WITH STORAGE TANK	8080
4	OIL FILTRATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTRATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1510
6	OIL FILTRATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	2020
7	OIL FILTRATION 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

**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

**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 DIAGNOSTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	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

**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