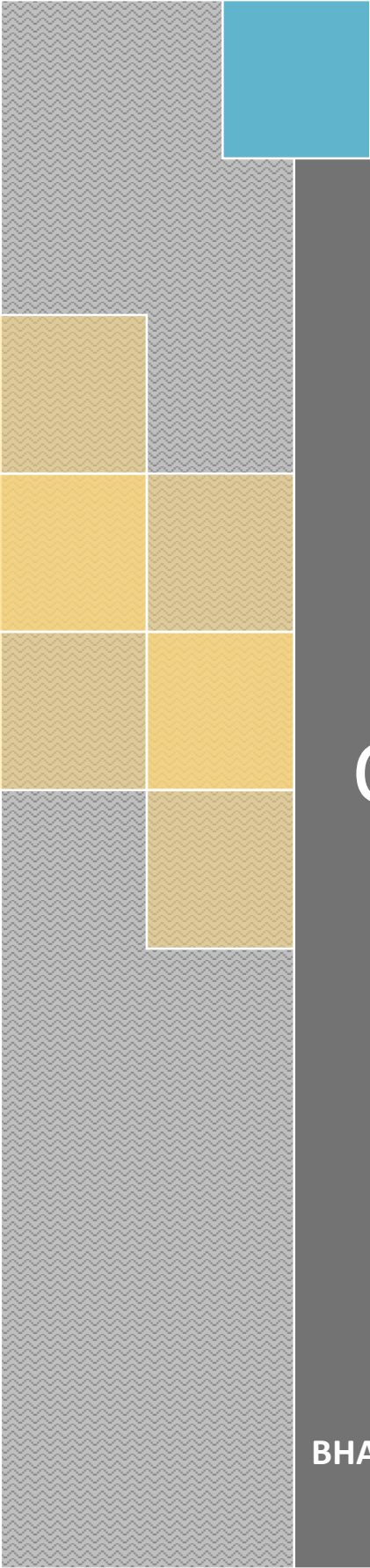




VOLUME – IA

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

1.1.0.0	Project Information	
01	Name of the Project	YADADRI Thermal Power Station
02	Station Capacity	5X800 MW (Coal based)
03	Owner	Telangana State Power Generation Corporation Limited (TSGENCO)
04	Site Location	Site is located 7 km from the NH565 (SH2). Veerlapalem village, Dameracherla Mandal, NALGONDA DISTRICT, TELANGANA STATE
05	Latitude	16° 42'20.40 N
06	Longitude	79° 34'41.56 E
07	Nearest Town	30 Km Miryalaguda
08	Nearest Railway Station	6.5 Km Damercherla
09	Nearest Airport	130 Kms (Vijayawada)
10	Site Conditions	
a.	Ambient Temperature	
i.	Daily minimum (average)	10°C
ii.	Daily maximum (average)	47°C
iii.	Design Ambient Temperature	50°C
iv.	Ambient temperature (performance)	38°C
b.	Relative Humidity for design / efficiency	48-84 %
c.	Annual rainfall, mm	600 mm
d.	Plant Elevation above MSL	85 m above MSL
e.	Mean Wind Speed	8 km/h
f.	Wind Pressure	As per the latest revision of IS 875/1987

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VOLUME-IA PART – I CHAPTER – II

C&I WORKS

SCOPE OF WORKS

1.2.1.0 SCOPE OF WORKS-GENERAL:

- 1.2.1.1 The scope of works covers C&I works of Main Plant (3 & 4) and identified BOP areas of 5x800 MW Yadadri TPS as mentioned below, including supply of labour, tools and plants. The Scope of the works is indicative but not limited to the given below.

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

1.2.1.2 BROAD SCOPE OF C&I WORKS:

A. Preassembly, Erection, Testing and Commissioning, Trial operation and reliability operation of:

1. Erection and commissioning of 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.
2. Erection of all Analyzers-Oxygen, HF, Flue Gas (SOX/NOX/CO), Mercury, NH₃, CO, SOX, NOX & Opacity
3. Erection of Vibration Monitoring System, Turbine Supervising Control and Monitoring System. Please refer the detailed scope of works in relevant chapters.
4. Erection of SWAS system with analyzers i.e. (Conductivity, Sodium, Iron, Silica, Chloride, Turbidity, Dissolved Oxygen, pH)
5. E&C of Microprocessor based flame scanner system, H.E.A Exciter system, Acoustic Steam Leak Detector, Coal Bunker Level Monitor system
6. Erection of Master Clock system
7. Erection & Commissioning of Large Video Screen System,
8. E&C of HART Management System under the Supervision of OEM

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9. Erection of UPS & Battery System of different kVA & AH ratings
10. Installation & Commissioning of Wireless communication, Station LAN, OPC Connectivity to all PLC (or) off site DCS wherever required
11. All type of Control Room instruments like Recorders, Indicators, Microprocessor based panels, DCS system and its accessories like system panels (Valmet Control Cabinets of SG/TG/BOP/CPU/EIS/T&AVT), Network Panels, Network Enclosures, PCs, Laptops, Printers, Computer Furniture etc.
12. Control & Instrumentation works associated with Fire Protection System (FPS) such as WBFPS/MVWSS/HVWSS/FBFPS/FDA/IGES systems of Units 3 & 4 i.e. Fire Alarm Panels, Repeater Panels, FDA/FPS panels, Fire Detectors, Modules, Power, Control & OLHS/LHS cables, OFC & Splicing, Instruments, etc.
13. All type of Pneumatic Power Cylinders, Controllers, Limit Switches, etc.
14. All type of Hardware like impulse pipes, Cable trays & tray supports, instrument airline, etc.
15. Laying, termination & testing of all types of power/control/instrumentation cables/Special Cables, etc.
16. Laying & Splicing of Optical Fiber Communication Cables with conduits
17. UPS, ACDB, Battery Chargers, Battery Health Monitoring panels, DCDB, Power Distribution Boards etc.
18. All type of Local/Remote control panels and LGB, LIE, LIR, Network Enclosures, Junction Boxes, Pushbutton stations.
19. Installation of any other items that have not been specifically indicated, but required for completing installation.

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

1. All types of Pneumatic/Motor Operated Valves/ Actuators/Power Cylinders/Controllers and Relief Valves.
2. Temperature Elements of all the HT Drives
3. Bidirectional Drives and Unidirectional Drives (HT/LT Drives) & Limit Switches
4. Removal, Calibration and fixing of the instruments in various systems as specified in the BOQ
5. Dosing Systems (Oxygen, NaOH, Ammonia & Hydrazine)
6. Demonstration of the Mechanical and C&I Lab instruments
7. Calibration of instruments at site with the contractor's own calibration and testing equipment under the supervision of BHEL/TSGENCO Engineers.

C. Others:

1. Final Painting including supply of paints, as detailed in scope of respective item/ equipment.
2. Supply of all consumables required for installation as detailed elsewhere in the specification.
3. Embossing Permanent nomenclature on equipment erected/Trays/ panels/wherever required as per site requirement.
4. Necessary arrangements for Protecting and safe guarding the Erected equipment from any damages and pilferages.
5. Installation of any other items that have not been specifically indicated, but required for completing installation.

Note:

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1. 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. Contractor shall have valid license to carry out the work indicated in the BOQ.
2. 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 Monitor, LVS System, HART Management System, Furnace Flame Viewing System, C&I Lab, Wireless Communication, Station LAN, OPC Connectivity to all PLC, etc. The contractor shall carry out the works as per instructions of BHEL/ OEM's Engineer.

1.2.3.0 EXCLUSIONS:

The following are specific exclusions from this work.

- a. Erection of Dampers, Pneumatic/Motor Operated Valves, Electrical Actuators, HT/LT Drives
- b. Attachment welding of thermocouple pads, Flow Nozzle, Orifice Plates and Control Valves
- c. Root Valves on the instruments tapping points
- d. Seal Welding on temperature stub on piping before hydra test.
- e. Removal of seal welding on temperature stub on piping after successful completion of hydra 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.

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- 1.2.4.0 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's, Testing instruments, returning of un-used materials / items to BHEL stores.
- 1.2.5.0 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.
- 1.2.6.0 The scope of specification covers the material receipt from BHEL stores, transportation to erection site, installation, testing and commissioning of the electrical equipment, hardware, software (data concentrator) communication along with accessories as detailed in Bill of Materials.
- 1.2.7.0 If any item or equipment not covered but requires 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. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.
- 1.2.8.0 **Note:** FOR BOQ& FURTHER DETAILED SCOPE OF WORKS REFER
RELEVANT CHAPTERS IN THIS BOOK

Note: Detailed BOM in 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.

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

1.3.1	PART-A-ESTABLISHMENT				
	Sl. No.	Description	Scope of BHEL	Scope of Bidder	Remarks
1.3.1.1	A	FOR CONSTRUCTION PURPOSE:			
	1	Open space for office	Yes		
	2	Open space for storage	Yes		
	3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
	4	Bidder's all office equipment, office / store / canteen consumables		Yes	
	5	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
	6	Firefighting equipment like buckets, extinguishers etc.		Yes	
	7	Fencing of storage area, office, canteen etc. of the bidder		Yes	
1.3.1.2	B	FOR LIVING PURPOSES OF THE BIDDER			
	1	Open space	Yes		
	2	Living accommodation		Yes	
1.3.1.3	C	ELECTRICITY			
	1	Electricity For construction purposes (to be specified whether chargeable or free)	Yes		
	1.a	Single point source	Yes		Free of Charges

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	Sl. No.	Description	Scope of BHEL	Scope of Bidder	Remarks
	1.b	Further distribution for the work to be done which include supply of materials and execution		Yes	
	2	Electricity for the office, stores, canteen etc. of the bidder which include		Yes	
	2.a	Distribution from single point including supply of materials and service		Yes	
	2.b	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
	2.c	Duties and deposits including statutory clearances for the above		Yes	
	2.d	Demobilization of the facilities after completion of works		Yes	
	3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc. on the above lines.(in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	
1.3.1.4	D	WATER SUPPLY			
	1	For construction purposes:	Yes		Free of Charges
	1.a	Making the water available at single point	Yes		Free of Charges
	1.b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.5	E	Water supply for bidder's office, stores, canteen etc.			
	1	Making the water available at single point		Yes	

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	Sl. No.	Description	Scope of BHEL	Scope of Bidder	Remarks
	2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.6	F	LIGHTING			
	1	For construction work (supply of all the necessary materials) At office storage area, At the preassembly area, At the construction site/area		Yes	
	2	For construction work (Execution of the lighting work/ arrangements) At office Storage Area, At the preassembly area, at the construction site/area		Yes	
1.3.1.7	G	COMMUNICATION FACILITIES for site operations of the bidder			
	1	Telephone, Fax, internet, internet, email etc. (min 2 Nos of PC & Printer) – 2 Data entry operator with computer knowledge		Yes	
1.3.1.8	H	COMPRESSED AIR SUPPLY			
	1	Supply of Compressor and all other equipment required for compressor & compressed air system including pipes, valves, storage systems etc		Yes	
	2	Installation of above system and operation & maintenance of the same		Yes	
	3	Supply of the all the consumables for the above system during the contract period		Yes	
1.3.2	PART-B -ERECTION FACILITIES				
	1	Engineering works for construction	Yes		

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	Sl. No.	Description	Scope of BHEL	Scope of Bidder	Remarks
	2	Providing the erection drawings for all the equipment covered under this scope	Yes		In consultation with BHEL
	3	Drawings for construction methods		Yes	In consultation with BHEL
	4	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	In consultation with BHEL
	5	Shipping lists etc for reference and planning the activities	Yes	Yes	In consultation with BHEL
	6	Preparation of site erection schedules and other input requirements		Yes	
	7	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments	Yes		In consultation with BHEL
	8	Weekly erection schedules based on SI No. 6		Yes	In consultation with BHEL
	9	Daily erection / work plan based on SI No. 7		Yes	In consultation with BHEL
	10	Periodic visit of the senior official of the bidder to site to review the progress so that works is 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	In consultation with BHEL
	11	Preparation of preassembly bay		Yes	

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	Sl. No.	Description	Scope of BHEL	Scope of Bidder	Remarks
	12	Laying of racks for gantry crane if provided by BHEL or brought by the contractor/bidder themselves			Not Applicable

1.3.3 LAND

1.3.3.1 Minimum Open space will be provided at free of charges to the contractor within the plant premises or adjacent to the plant boundary for construction of temporary office shed, contractor's stores shed(s). Contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated for un- insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for their site office, covered store or any other temporary building. Alternatively, contractor can adopt readymade 'porta cabin" or similar construction.

1.3.3.2 BHEL shall not provide to the contractor any residential accommodation to any of their staff and the contractor has to make their own arrangements. Only Land for Labour colony and staff colony will be provided by BHEL adjacent to the plant boundary to contractor at free of cost. Contractor has to make their own arrangements for labour colony.

1.3.3.3 Contractor has to furnish the details of requirements of area of space for their office, stores, storage shed, labour colony etc. at site before starting the work to BHEL Site Engineer.

1.3.3.4 Location and area requirement for office / storage sheds / fabrication yard shall be discussed and mutually agreed to.

1.3.4 ELECTRICITY:

1.3.4.1 The construction power (415V) will be provided at a single point for construction purpose free of charge. Construction power shall be provided from the nearest Substation / tapping point within the plant premises. For the purpose of measurement of power consumed, the contractor shall provide Energy meter with valid calibration certificate. Distribution from this source to different locations is to be arranged by the bidder at their cost.

1.3.4.2 Electricity for labour colony and staff colony will be provided at single point on chargeable basis at the prevailing rate of TSGENCO. Distribution from this source to different locations is to be arranged by the bidder at their cost.

1.3.4.3 Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards to contractor's office shed also, all such expenditure shall be borne by the contractor. Demand charges if any to be borne by the contractor.

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- 1.3.4.4 Provision of distribution of electrical power from the given points 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.
- 1.3.4.5 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.
- 1.3.4.6 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.8 shall be provided by the contractor at their cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.
- 1.3.4.7 Contractor has to make their own arrangements for their electricity requirement for their labour colony at their cost incase Electricity is not provided by TSGENCO.
- 1.3.4.8 As there are bound to be interruptions in regular power supply, power cut/load shedding in any construction sites, contractor should make their own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown /failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency

1.3.5 CONSTRUCTION WATER

- 1.3.5.1 Water (Raw water) required for construction purposes will be provided at one single point within the plant area at free of charge for construction purpose and bidder has to make their own arrangement for further distribution by arranging required pipes, valves, pumps, etc.
- 1.3.5.2 Water (Raw water) for labour colony and staff colony shall be provided at single point on chargeable basis at the prevailing Government Tariff and bidder has to make their own arrangement for further distribution by arranging required pipes, valves, pumps, etc.
- 1.3.5.3 Incase non-availability of water, the contractor shall make their own arrangements of water suitable for construction purpose to have uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply. Contractor has to make their own arrangements for their water requirement for their labour colony at their cost.

1.3.6 DRINKING WATER

Bidder shall provide drinking water at the work spot at their cost.

1.3.7 ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS]

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Contractor has to provide at BHEL office, minimum two (02) computers and printers along with refilling of cartridges whenever required (along with one operator per PC) for online material management, reporting of daily progress, billing and other similar activities, within the quoted rate. Computers shall have minimum configuration of minimum Windows 7 OS, 4GB RAM and Internet Explorer 8 or above.

1.3.8 CONSUMABLES:

- 1.3.8.1 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.
- 1.3.8.2 All the required electrodes (in their scope) as approved by BHEL shall be arranged by contractor at their cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement regarding, suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc.
- 1.3.8.3 All electrodes including stainless steel electrodes required for shall be arranged by the contractor at their cost. The bidder shall use the Customer approved quality welding electrodes only.
- 1.3.8.4 The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including alloy steel and stainless steel), 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, 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 them. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by them.
- 1.3.8.5 All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.
- 1.3.8.6 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.

1.3.9 MATERIAL SUPPLY:

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

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1.3.10 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 (2 to 4) diesel operated generator sets for welding to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by tenderers. This may also be noted while quoting. No separate payment shall be made for this contingency.

1.3.11 LIGHTING FACILITY (with ELCB):

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 their cost.

1.3.12 GASES:

1.3.12.1 All the required gases like Oxygen / Acetylene / argon /Nitrogen required for work shall be supplied by the Contractor at their cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non-availability of gases cannot be considered as reason for not attaining the required progress.

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

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

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

1.3.13 ELECTRODES SUPPLY AND STORAGE:

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

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

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- 1.3.13.3 Shortage of any of the electrodes or the equivalent suggested by BHEL shall not be quoted as reason for deficiency in progress or for additional rate. Contractor shall submit weekly/ fortnightly/ monthly statement/ report regarding consumption and available stock of all types of electrodes for avoiding stoppage of work on consumable scarcity.
- 1.3.13.4 Storage of electrodes shall be done in an air conditioned / controlled humidity room as per requirement, at their own cost by the contractor.
- 1.3.13.5 All low hydrogen electrodes shall be baked / dried in the electrode drying oven (range 375 deg. C - 425 deg. C) to the temperature and period specified by the BHEL Engineer before they are used in erection work and each welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by contractor at their cost.
- 1.3.13.6 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.
- 1.3.13.7 BHEL reserves the right to reject the use of any electrodes at any stage, if found defective because of bad quality, improper storage, date expiry, unapproved type of electrodes etc. It shall be the responsibility of the contractor to replace at their cost without loss of time.
- 1.3.14 OTHER FACILITIES:**
Adequate waterless urinals [at least 2 nos per level] shall be arranged by the contractor within quoted rates, at site of construction at different level and different areas like boiler structure, with proper disposal arrangement.
- 1.3.15 MATERIALS /CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR AT THEIR COST FOR ERECTION AND COMMISSIONING OF RESPECTIVE EQUIPMENTS/ITEMS.**
- 1.3.15.1 All welding electrodes, filler wires, gases shall be arranged by the contractor at their cost.
- 1.3.15.2 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.
- 1.3.15.3 **Other items:**
1. Provision for Temporary scaffoldings
2. Insulation tapes
3. Paints required for primer coating & final coating and for protective coating. paint of approved colour, consumables like thinner brushes, emery paper etc.,

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4. Solder wire (Lead 60/40)
5. Protocol / calibration report sheets as per BHEL format
6. PVC wire marker sleeves and tag plates
7. Panel / JB sealing compound material (for cable entry from bottom / top of panel)
8. Materials required for cable dressing (GI / Aluminium Flats, PVC Cable ties, etc)
9. Anchor fasteners for wall mounted cable trays & JBs wherever required.
10. PVC wire marker sleeves and tag plates
11. Lugs of size 2.5 sq.mm and below
12. "U" clamps with nuts and washers for impulse pipes and GI pipe clamping.
13. Tag Plats-Al/Fiberglass/Stainless Steel
14. Insulation Tapes
15. Teflon Tap for GI pipe coupling
16. Protocol/Calibration report sheets as per BHEL format
17. Fastener for mounting JB, Local PB boxes and earthing flats.
18. PVC cable tie, Aluminum or GI strips and fasteners for clamping of cables and other dressing materials required for cable dressing, grommet sleeves for cables.

1.3.16 TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

1.3.16.1 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

1.3.16.2 FERRULES:

Colour of Ferrules	Yellow/White
Colour of Engraving	Black

1.3.16.3 TAGS:

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

1.3.17 POWER REQUIREMENT:

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 before starting the work at site to BHEL Site Engineer.

1.3.18 CONTRACTOR'S OBLIGATION ON COMPLETION:

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

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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 T&Ps and MMES TO BE DEPLOYED BY CONTRACTOR:

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.

- 1.4.1 The following minimum Instruments / T&P shall be arranged by contractor in sufficient number to carry out the job simultaneously in more than one area.

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.	02 Nos.
02	Oil temperature bath suitable to calibrate upto 400° C	02 Nos.
03	Furnace range 600 Deg C	01 No.
04	Standard Pressure Gauges as below :	
	0 to 1 kg/Sq.cm	01 No.
	0 to 5/6 kg/Sq.cm	01 No.
	0 to 10 kg/Sq.cm	01 No.
	0 to 16 kg/Sq.cm	01 No.
	0 to 25 kg/Sq.cm	01 No.
	0 to 60 kg/Sq.cm	01 No.
	0 to 100 kg/Sq.cm	01 No.
05	Standard Temperature Gauges as below :	
	0 to 100 Deg C	02 No.
	0 to 200 Deg C	02 No.
	0 to 600 Deg C	02 No.
06	Standard compound pressure gauge -1 to +3 kg/Sq.cm	02 No.
07	Standard Vacuum Gauge -760 mm Hg to 0 kg/Sq.cm	01 No.
08	Portable air compressor with drier and regulator rated for 10 kg/Sq.cm	01 No.
09	Manometer 0 to 1000 mm WC with hand bulb	03 Nos.
10	Vacuum pump with standard vacuum gauge	01 No.
11	Standard Milliamps Source (Digital)	03 Nos.
12	Standard Millivolts Source (Digital)	03 Nos.
13	Mercury Manometer different range	04 Nos.
14	DC Power Supply , 24 V ; 5A	03 Nos.

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15	Single Phase Variac 250V; 10A	01 Nos.
16	Glass Thermometers of ranges in Deg C as below: 0-120 ; 0-200; 0-600	02 Nos. each
17	Tong tester AC 5/10/25 ; KEW Snap Make	01 No. each
18	Function Generator	01 No.
19	Hand Operated Megger 500V ; 2.5 kV / 100 M Ohms	Each type As required
20	Torque wrench	As required
21	AC Voltmeter 0-125 ; 250 ; 625V	01 No. each
22	AC Ammeter 0-2A ; 10A	01 No. each
23	Analog Multimeter Motwane Make	03 Nos.
24	Digital Multimeter 3 1/2 Digit	08 Nos.
25	Digital Multimeter 4 1/2 Digit	03 Nos.
26	Wire wrapping tool	As required
27	Oscilloscope	01 Nos.
28	Soldering irons, soldering pump, Vacuum cleaner, Air blower etc.	As required

B. List of Recommended Tools & Plants

S.No.	DESCRIPTION	QUANTITY
01	Steel wire ropes	As required
02	Chain pulley block / turfer	As required
03	2 " size pipe bending machine	As required
04	Grinding machine	As required
05	Drilling machines : 1/4" , 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	1 No.
11	Spirit level	As required
12	Tap sets for both BSP & NPT threads upto 1 "	1 Set each
13	Measuring instruments like micrometers,calipers etc.	1 each
14	Welding generator	1 No.
15	Welding transformer	As required
16	TIG Welding set	1 No.
17	Mechanical tool kit for fitters	As required
18	Electrician tool kit	As required
19	Crimping tool	As required
20	Flood light fittings	As required
21	Fire extinguishers	As required

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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 and their quantity as mentioned in above list are the suggestive requirement considering parallel working. However, its mobilization, quantity and period of T&Ps deployment will be mutually agreed at site as per actual requirement.

b) 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 its 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.

1.4.2

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	
		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	$\pm 1.5\%$	

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		Resistance upto 100 ohms	± 3.0%	
		Voltage 2.5 V to 2500 V	± 1 %	
03	MV/mV Source	0 to 200 mA / 200mV	0.2%	
04	Hand operated Megger 500V /1000 V	Upto 200 m Ohms	± 5% at Centre scale	10"
05	Standard Pressure Gauges	0 to 1 kg/cm ²	±0.25% LC– 0.02 kg/ cm ²	10"
		0 to 6 kg/cm ²	±0.25% LC– 0.1 kg/ cm ²	10"
		0 to 10 kg/ cm ²	±0.25% LC– 0.02kg/ cm ²	10"
		0 to 25 kg/ cm ²	±0.25% LC– 0.25kg/ cm ²	10"
		0 to 60 kg/ cm ²	±0.25% LC– 0.1kg/ cm ²	10"
		0 to 250 kg/ cm ²	±0.25% LC– 2.5kg/ cm ²	10"
		0 to 400 kg/ cm ²	±0.25% LC– 2.5 kg/ cm ²	10"
		0 to 600 kg/ cm ²	±0.25% LC– 2.5 kg/ cm ²	10"
		0 to 1000 kg/ cm ²	±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 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 420°C	LC - 1°C	

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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	Tongue tester	0/300/600 A AC	± 5%	
		0 to 300 A DC	± 5%	
12	Tacho Meter (Hand held)	0 to 4000 rpm	± 5%	
13	Phase Sequence Meter		N/A	
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	± 5% at Centre Scale range	
15	DC Ammeter	0 to 300 A	± 10%	
16	DC Voltmeter	0 to 500 V	± 10%	

Note:

1. For loading and transportation, all necessary T & P such as Trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor. All the tools & plants required for this scope of work, except the tools & plants provided by BHEL are to be arranged by the contractor within the quoted rates.
2. **Note for Contractor's Instruments:**
 - 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. The above instruments / equipment will be sent for testing and calibration wherever from time to time and maintained by contractor as required by BHEL.

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- 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.
- 1.4.3 T&Ps mentioned above is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers / time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipment to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL. Vendor will give advance intimation and certification regarding capacity etc. prior to dispatch of heavy equipment. Also on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement.
- 1.4.4 Computerized ferrules printing machine (min – 01 No.) shall be provided for making printed ferrules for all the cables.
- 1.4.5 **PROTECTION / HANDLING OF TOOLS AND PLANT ARRANGED BY THE CONTRACTOR**
 - 1.4.5.1 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.
 - 1.4.5.2 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.
 - 1.4.5.3 No material or equipment or tools etc., shall be taken out of the work-site without the written consent of BHEL.

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- 1.4.5.4 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.
- 1.4.5.5 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.
- 1.4.5.6 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 Volume I Book I TCC- Volume IA Part II) as per following cases:

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

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

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

1.4.6.0 CALIBRATION RECORD OF SUB-CONTRACTOR’S INSTRUMENTS

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

- 1.5. 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.
1. EOT Crane at the respective TG Hall without operator– 01 No.
- 1.5.2 EOT crane without operating personnel shall be made available in the TG Hall free of charge. The contractor has to arrange operator for EOT Crane. EOT crane will be allocated for execution of C&I work including shifting the panels within power house building on sharing basis at free of hire charges. The decision of BHEL Engineers will be final with regard to allotment of crane.
- 1.5.3 Experienced Crane operator for EOT crane to be arranged by the bidder at their cost.
- 1.5.4 Providing manpower assistance required for free movement of Trailing cable of EOT Crane is also scope of the bidder at their cost.
- 1.5.5 The availability of crane is likely to be hampered from time to time due to routine preventive maintenance or breakdown maintenance. Contractor has to make alternative arrangement or plan / modify / alter their activities to suit the above conditions and the contractor will not be liable for any compensation or extension of time due to this non-availability, for maintaining the erection schedule.
- 1.5.6 In the event of the crane not available for longer duration due to major breakdown or any other reasons, BHEL will reschedule the work in consultation with bidder and direct the bidder to concentrate on other areas till such time the cranes are made available.
- 1.5.7 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.5.8 All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections for the BHEL issued T & Ps shall have to be arranged by the contractor at their cost.
- 1.5.9 Contractor shall make good any loss or damage to the equipment's supplied to them and day to day maintenance and operations of equipment's shall be borne by the contractor including all consumables like petrol, oil and air filters etc.,

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- 1.5.10 BHEL may provide either BHEL owned or hired 75T (or above capacity) cranes as per site requirement for erection at the discretion of BHEL.
- 1.5.11 In the event of providing BHEL owned cranes:**
- 1.5.11.1 BHEL shall provide crane operator at free of charges.
- 1.5.11.2 Fuel and lubricants are to be arranged by the contractor within the quoted rate.
- 1.5.11.3 Maintenance for the BHEL own cranes shall be carried out by BHEL. However, all the consumables for the maintenance of BHEL own cranes shall be provided by the contractor within the quoted rates. The Tentative List of consumables required to be provided by contractor from the BHEL/OEM recommended supplier is as below:
- a. Engine Oil
 - b. Fuel Filters
 - c. Air Filters
 - d. Hydraulic Oil
 - e. Hydraulic Filters
 - f. Gear Oil
 - g. Engine Oil Filter
 - h. Oil Separator Filter
 - i. Rope
 - j. Grease
 - k. Maintenance for the BHEL cranes shall be carried out by BHEL. The bidder shall extend support if required for routine maintenance works without any additional cost.
- 1.5.12 In the event of providing hired cranes:**
- 1.5.12.1 Crane Operators for hired cranes will be provided by BHEL, free of charges.
- 1.5.12.2 Fuel and lubricants are to be arranged by the contractor within the quoted rate.
- 1.5.13 Cranes provided by BHEL are only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.
- 1.5.14 Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional T & Ps which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at their cost. In case if the contractor fails to provide such equipment, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.

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- 1.5.15 Any loss / damage to any or part of the BHEL T&Ps by the contractor shall have to be replaced or otherwise cost thereof shall be recovered from the contractor.
- 1.5.16 All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections shall have to be arranged by the contractor at their cost.
- 1.5.17 Necessary electrical / water / air connection required for operation of any of the tools & tackles shall be in the Contractor's scope.
- 1.5.18 Apart from the above mentioned tools, any other tools and plants including suitable Jacks / Hydraulics jacks required for satisfactory completion of the work has to be arranged by the contractor. 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.
- 1.5.19 For the cranes, the required consolidation and preparation for placing crane for operation (civil work) is under bidder scope and also necessary plates / sleepers required for marching operation shall be provided by the contractor within quoted rates.
- 1.5.20 For movement of cranes etc., it may become necessary to lay sleeper bed for obtaining leveled safe approach for usage of equipment. It shall be the responsibility of the contractor to lay necessary sleeper's. The sleepers shall be arranged by the contractor at their cost.
- 1.5.21 The contractor at their cost shall arrange for grouting of anchor points of T&Ps issued to them. Necessary grout materials are to be arranged by the contractor at their cost.
- 1.5.22 In case of non-availability of any of these equipment, due to any reason i.e., unavoidable breakdown, major overhaul or any other reason etc., the contractor should make arrangement at their cost to meet the erection targets. No extra claim will be admitted due to non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.

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TIME SCHEDULE

1.6.1 TIME SCHEDULE

1.6.1.1 The entire work of erection testing and commissioning as detailed in the Tender Specification shall be completed within **20 (Twenty)** months from the date of commencement of work at site.

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

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

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

1.6.2 COMMENCEMENT OF CONTRACT PERIOD

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

1.6.3 MOBILIZATION 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 their resources in such a manner that following major milestones of erection & commission are achieved on specified schedules:

A. Major Milestones		
Milestone Activity	Unit # 3	Unit # 4
1. Start of work	01 st Month	01 st Month
2. Readiness for Boiler Light Up	05 th Month	07 th Month
3. Readiness for Synchronization	09 th Month	11 th Month
4. Trial Operation	14 th Month	14 th Month
5. Balance work completion, pending points, punch points liquidation	20 th Month	20 th Month

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B. Intermediate Milestones	
Readiness for Boiler Light Up of the first unit (M1)	5th Month
Readiness for Synchronization of the later unit (M2)	11th Month

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

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

1.6.4 PENALTY FOR INTERMEDIATE MILESTONES

1.6.4.1 M1 and M2 shall be intermediate for respective works.

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

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

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

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

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

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

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1.6.5 CONTRACT PERIOD

The contract period for completion of entire work for each unit under scope shall be 20 (Twenty) months from the “COMMENCEMENT OF CONTRACT PERIOD” as specified earlier.

1.6.6 GUARANTEE PERIOD

The guarantee period of 12 months shall commence from the date of handing over of the later Unit to Customer (or) Six months from the date of first synchronization of the later unit, whichever is earlier.

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

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TERMS OF PAYMENT

1.7.	Terms of Payment: The progressive payment for erection, testing and commissioning on accepted rate / price of contract value will be released as mentioned below.	
1.7.1	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 1.7.2.1.1 to 1.7.2.12.1 of the following table.	
Sl. No.	Activity / Work Description	% of unit rate
1.7.2	PRO RATA PAYMENTS (85%)	
1.7.2.1	For all type of Instruments including Power Cylinder/Actuator	
1.7.2.1.1	Receipt, transport to erection site, assembly, checking, calibration, fixing and clamping Adjustment, Alignment, on prorata basis and protocol signed	60%
1.7.2.1.2	Pre-commissioning tests, checks, and making ready for energisation pro rata basis and protocol signed	15%
1.7.2.1.3	Completion of commissioning	10%
	Total =	85%
1.7.2.2	Cable laying including Earthing wires	
1.7.2.2.1	Laying/tagging/termination of cables / Wires	65%
1.7.2.2.2	Checking, Dressing and Clamping	10%
1.7.2.2.3	Loop Checking and Commissioning	10%
	Total =	85%
1.7.2.3	AC&DCDB/MMI/PLC system and all types of control panels including MMIPIS(DCS) Related Instrumentation other than Valmet DCS control panels Erection	
1.7.2.3.1	Receipt transport to erection site, placement, assembly, fixing and clamping adjustment, alignment, grouting and electrical interconnections on prorata basis and protocol signed	65%
1.7.2.3.2	Pre-commissioning tests, checks and making ready for energisation on prorata basis and protocol signed	10%
1.7.2.3.3	Completion of Commissioning	10%
	Total =	85%
1.7.2.4	Valmet DCS control panels Erection	

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1.7.2.4.1	Receipt, Transport to Unit Control Room, Placement, assembly and Erection of Valmet DCS control panels on prorata basis and protocol signed	95%
	Reconciliation and Final bill	5%
	Total =	100%
1.7.2.5	Valmet DCS control panels Commissioning	
1.7.2.5.1	Aligning & Electrical Interconnections on prorata basis and protocol signed	65%
1.7.2.5.2	Pre-Commissioning tests, checks and making ready for energisation on prorata basis and protocol signed	10%
1.7.2.5.3	Completion of Commissioning	10%
	Total =	85%
1.7.2.6	For fabrication and installation of steel materials including LIR/LIE	
1.7.2.6.1	Fabrication / Pre assembly and applying primer paint	45%
1.7.2.6.2	Erection, Alignment, welding/bolting and if applicable chipping/grouting/painting	40%
	Total =	85%
1.7.2.7	For UPS/Battery sets/charger	
1.7.2.7.1	Receipt, transport to erection site, checking, placement, assembly, grouting, mounting and wiring of loose components	50%
1.7.2.7.2	Adjustment, alignment, inter connections and pouring of Alkali	20%
1.7.2.7.3	Pre-commissioning test checks and making ready for energization	15%
	Total =	85%
1.7.2.8	For cable trays, tray supports, Rigid and flexible conduits & copper tubes, earthing	
1.7.2.8.1	On satisfactory completion of work on prorata basis	70%
1.7.2.8.2	On completion of drawing or area wise on prorata basis	15%
	Total =	85%
1.7.2.9	For Impulse Pipes	
1.7.2.9.1	On laying and welding on prorata basis and protocol signed	50%
1.7.2.9.2	On clamping and painting on prorata basis and protocol signed	20%
1.7.2.9.3	System Charging	15%
	Total =	85%
1.7.2.10	Testing / Commissioning of Equipment erected by other Agencies	

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1.7.2.10.1	On completion of commissioning of individual racks / skid / actuators / Loop checking/Instruments etc. on prorata Basis	60%
1.7.2.10.2	On completion of commissioning of main equipment/system on prorata basis	15%
1.7.2.10.3	Final completion of the system along with customer handing over protocols	10%
	Total =	85%
1.7.2.11	Other items (Misc Item) – EPBAX, Wireless communication, C&I lab, firefighting, water treatment packages, etc.	
1.7.2.11.1	Completion of work(erection, alignment & testing) of the respective item/equipment	75%
1.7.2.11.2	Completion of Commissioning of the respective item/equipment -on pro rata basis.	10%
	Total =	85%
1.7.2.12	For Supply Items (If applicable)	
1.7.2.12.1	On submission of running bill along with the Stores Receipt /Voucher/Stores endorsement issued by BHEL on prorata basis	85%
	Total =	85%
1.7.2.13	STAGE / MILESTONE PAYMENTS (15%) except for Valmet DCS control panels Erection	% of unit rate
1.7.2.13.1	Boiler Light Up	1%
1.7.2.13.2	ABO/Chemical/EDTA cleaning	1%
1.7.2.13.3	Safety Valve floating (Electromatic Relief Valves)	1%
1.7.2.13.4	Rolling and Synchronization	2%
1.7.2.13.5	Coal Firing	1%
1.7.2.13.6	Full Load	2%
1.7.2.13.7	Trial Operation of Unit	2%
1.7.2.13.8	Area cleaning, temp structure cutting/ removal and return of scrap	1%
1.7.2.13.9	Punch List points / pending points liquidation	1%
1.7.2.13.10	Submission of 'As Built Drawings'	1%
1.7.2.13.11	Monthly Material Reconciliation	1%
1.7.2.13.12	Completion of Contractual Obligation	1%
	Total for Stage / Milestone Payments (15%)	15%
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.		

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

Goods and service Tax (GST) & Cess

- 1.8.1.1 The successful bidder shall furnish proof of GST registration with GSTN Portal in the State in which the Project is being executed, covering the 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.
- 1.8.1.2 Contractor's price/rates shall be exclusive of GST & Cess (if applicable) (herein after termed as GST). Contractor shall submit to BHEL the GST compliant tax invoice/debit note/revised tax invoice on the basis of which BHEL will claim the input tax credit in its return. Since this is a works contract, the applicable rate shall be @ 18% GST, as applicable presently.
- 1.8.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill To' details will as below:
- BHEL GSTN - 36AAACB4146P1ZG
NAME - BHARAT HEAVY ELECTRICALS LIMITED
ADDRESS - BHEL-PSSR SITE OFFICE, Yadadri Thermal Power Station,
5X800 MW (Coal based), Veerlapalem village, Dameracherla Mandal,
Nalgonda District, Telangana State
- 1.8.1.4 GST charged in the tax invoice/debit note/revised tax invoice by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return.
- 1.8.1.5 In case BHEL has to incur any liability (like interest / penalty etc.) due to denial/reversal / delay of input tax credit in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.
- 1.8.1.6 Further, in case BHEL is deprived of the Input tax credit due to any reason attributable to contractor, the same shall not be paid or Recovered if already paid to the contractor.
- 1.8.1.7 Tax invoice/debit Note/revised tax invoice shall contain all such particulars as prescribed in GST law and comply to the timelines for issue of the same. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge.
- 1.8.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.
- 1.8.1.9 E-way bills / Transit passes / Road Permits, if required for materials / T&P etc.,

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bought into the project site is to be arranged by the Contractor only.

- 1.8.1.10 BHEL shall not reimburse any amounts towards any interest / penalty etc., incurred by contractor. Any additional claim at a later date due to issues such as wrong rates / wrong classification by contractor shall not be paid by BHEL.

1.8.2 All taxes and duty other than GST & Cess

The contractor shall pay all (except the specific exclusion viz GST & Cess) taxes, fees, license charges, deposits, duties, tools, royalty, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods & 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.

1.8.3 Statutory Variations

Statutory variations are applicable under the GST Acts, against production of proof. The changes implemented by the Central / State Government during the tenure of the contract viz. increase / decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitably paid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favor of BHEL. No other variations shall be allowed during the tenure of the contract.

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.

1.8.5 Direct Tax

BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

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VOLUME-IA PART – I CHAPTER - IX WEIGHT SCHEDULE/BOQ

1.9. C&I - BILL OF QUANTITY (BOQ)

1.9.1 BOQ of Unit # 3 & 4

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A	EDN SCOPE			
A.1.0	Shifting from Stores to UCR, placement, Alignment & erection of SG Package- Valmet DNA Control Cabinets			
A.1.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CJF75&CJF76, CJF34&35	Nos	2	2
A.1.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CAF41&CAF42	Nos	1	0
A.1.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg.CJF06,07,08	Nos	1	1
A.1.4	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJF23/24-CAF20/21, CJF25/26- CAF22/23 & CJF27/28-CAF24/25 & CJF29/30-CAF26/27	Nos	4	4
A.1.5	Suit of five Cubicles Size: 3750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 2000 kg. CJF01,02,03,04,05 & CJF58,59,60,61,62	Nos	2	2
A.1.0.1	Minor Alignment, Electrical Interconnection, Testing and Commissioning of SG Package-Valmet DNA Control Cabinets			
A.1.1.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CJF75&CJF76, CJF34&35	Nos	2	2
A.1.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CAF41&CAF42	Nos	1	0
A.1.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg.CJF06,07,08	Nos	1	1
A.1.4.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJF23/24-CAF20/21, CJF25/26- CAF22/23 & CJF27/28-CAF24/25 & CJF29/30-CAF26/27	Nos	4	4
A.1.5.1	Suit of five Cubicles Size: 3750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 2000 kg. CJF01,02,03,04,05 & CJF58,59,60,61,62	Nos	2	2

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.2.0	Shifting from Stores to UCR, placement, alignment & erection of TG Package- (Non-Core) Valmet DNA control cabinets			
A.2.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CJJ08, CJJ41 & CWW01	Nos	3	3
A.2.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CCA10 & CCA 11	Nos	1	1
A.2.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJJ03,CJJ04 & CJJ53	Nos	1	1
A.2.4	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJJ01,02,05,06, CCA01,02,03,04, CJJ20,21,22,23 & CJJ30,31,32,33	Nos	4	4
A.2.0.1	Minor Alignment, Electrical Interconnection, Testing and Commissioning of TG Package- (Non-Core) Valmet DNA control cabinets			
A.2.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CJJ08, CJJ41 & CWW01	Nos	3	3
A.2.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CCA10 & CCA 11	Nos	1	1
A.2.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJJ03,CJJ04 & CJJ53	Nos	1	1
A.2.4.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJJ01,02,05,06, CCA01,02,03,04, CJJ20,21,22,23 & CJJ30,31,32,33	Nos	4	4
A.3.0	Shifting from Stores to UCR, placement, alignment & erection of STN C&I Valmet DNA Control Cabinets			
A.3.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CRE61/CTE01/CTE02/CTE03	Nos	4	4
A.3.2	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE04	Nos	1	0
A.3.3	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE51/52, CRE81/82, CRE53/54, CRE83/84, CRE55/56, CRE57/58, CRE59/60	Nos	7	7
A.3.4	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE77/78	Nos	1	0

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.3.5	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRE41/42/43, CRE48/49/50, CRE62/63/64, CRE65/66/67, CRE68/69/70	Nos	5	5
A.3.6	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRW01-03, 04-06, 11-13, 71-73, 74-76	Nos	5	0
A.3.7	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRE 01-04,05-08, 09-12,13-16,17-20,21-24,25-28,29-32,33-36,37-40,44-47	Nos	11	11
A.3.8	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRW07-10	Nos	1	0
A.3.0.1	Minor Alignment, Electrical Interconnection, Testing and Commissioning of STN C&I Valmet DNA Control Cabinets			
A.3.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CRE61/CTE01/CTE02/CTE03	Nos	4	4
A.3.2.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE04	Nos	1	0
A.3.3.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE51/52, CRE81/82, CRE53/54, CRE83/84, CRE55/56, CRE57/58, CRE59/60	Nos	7	7
A.3.4.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE77/78	Nos	1	0
A.3.5.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRE41/42/43, CRE48/49/50, CRE62/63/64, CRE65/66/67, CRE68/69/70	Nos	5	5
A.3.6.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRW01-03, 04-06, 11-13, 71-73, 74-76	Nos	5	0
A.3.7.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRE 01-04,05-08, 09-12,13-16,17-20,21-24,25-28,29-32,33-36,37-40,44-47	Nos	11	11
A.3.8.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRW07-10	Nos	1	0
A.4.0	Shifting from Stores to UCR, placement, alignment & erection of CPU C&I Valmet DNA Control Cabinets			
A.4.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE11, CTE12,CTE13, CTE14 & CTE16	Nos	5	0

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.4.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRA10/11	Nos	1	0
A.4.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRA01-03, 04-06, 07-09,12-14	Nos	4	0
A.4.0.1	Minor Alignment, Electrical Interconnection, Testing and Commissioning of CPU C&I Valmet DNA Control Cabinets			
A.4.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE11, CTE12,CTE13, CTE14 & CTE16	Nos	5	0
A.4.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRA10/11	Nos	1	0
A.4.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRA01-03, 04-06, 07-09,12-14	Nos	4	0
A.5.0	Shifting from Stores to UCR, placement, alignment & erection of SCR C&I Valmet DNA Control Cabinets			
A.5.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB01-03 & 04-06	Nos	2	2
A.5.0.1	Minor Alignment, Electrical Interconnection, Testing and Commissioning of SCR C&I Valmet DNA Control Cabinets			
A.5.1.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB01-03 & 04-06	Nos	2	2
A.6.0	Shifting from Stores to UCR, placement, alignment & erection of T&AVT/EIS Control Cabinets & Network Panels/Network Enclosures			
A.6.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CFA01	Nos	1	0
A.6.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CXA01-02 & 03-04	Nos	2	0
A.6.3	EIS Control Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CYJ01	Nos	1	1
A.6.0.1	Minor Alignment, Electrical Interconnection, Testing and Commissioning of T&AVT/EIS Control Cabinets & Network Panels/Network Enclosures			
A.6.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CFA01	Nos	1	0
A.6.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CXA01-02 & 03-04	Nos	2	0

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.6.3.1	EIS Control Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CYJ01	Nos	1	1
A.6.0.2	Shifting from Stores to UCR, placement, alignment, Erection, testing and Commissioning of Network Panels and Network Enclosures.			
A.6.0.2.1	Network Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP11/21/41	Nos	3	3
A.6.0.2.2	Network Panel (LAN-I/II) of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP51/52	Nos	1	0
A.6.0.2.3	Network Panel (Common System) of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP31/32/33/35/36/37	Nos	3	0
A.6.0.2.4	Network Enclosures for LAN & BOP Systems of Size: 600 mm(W) X 500 mm(D) x 600 mm(H); Approx. weight 20 kg.	Nos	6	0
A.7.0	TURBINE SUPERVISORY SYSTEM FOR MAIN TURBINE			
A.7.1	Meggitt VM600 system with 19" Rack Control Cabinet- 2 Nos. (with power supply unit, back panel, CPU module, I/O cards, relay cards, protection cards), TFT monitors, server, A3 Colour printer, Ethernet to FO convertor, interconnecting cables, etc. Approx. Size and Weight of the Panel 750 x 800 x 2117 mm; 400 kg.	Set	1	1
A.7.2	Collection of materials from stores, Preparation of mounting surface and mounting arrangement to suit the surface of the machine, Installation of JB's- 12 Nos., Laying & Terminations of Instrumentation cable from Lcal JB and Cabinet, Laying and termination of Power cable to TSS panel, Laying and termination of ethernet cables (as applicable), Laying and Termination of FO cables. (Mounting sensors on the Machines, Laying and termination of cables between sensors to Local JB, Pre-commissioning check, energizing cabinets & PC (as applicable), Commissioning, Installation of software packages, handing over to the enduser are in the scope of OEM).	Set	1	1
A.8.0	Erection, Testing and Commissioning of HART MANAGEMENT SYSTEM under the Supervision of OEM)			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.8.1	Hart Management System (HMS) Comprising of the following: HART Panel- 02 Nos., Workstation PC with 24" TFT Monitor-02 Nos., Colour laser Printer 01 No., and other loose supplied items like Hart / back plane communication modules, Patch cards/ 20 way FRC intra panel cables 69 set, RS485/RS232 Convertor, interconnecting Cables, etc. Approx. Size and Weight of the Panel 800(L) x 800(W) x 2415(H) mm; 400 Kg each.	Set	1	1
A.9.0	Erection, Testing, Calibration and Commissioning of Field Instruments			
A.9.1	Pressure Transmitter	Nos	265	195
A.9.2	Differential Pressure Transmitter	Nos	141	128
A.9.3	Ultrasonic type level transmitter	Nos	48	27
A.9.4	Flow Transmitter (DP type)	Nos	128	121
A.9.5	Guided Wave Radar Type Level Transmitter	Nos	24	24
A.9.6	Temperature Elements	Nos	330	330
A.9.7	Pressure Gauge	Nos	151	151
A.9.8	Differential Pressure Gauge	Nos	20	20
A.9.9	Pressure and Differential Pressure switches	Nos	60	60
A.9.10	Temperature Gauge	Nos	130	130
A.9.11	Level Gauge	Nos	1	1
A.9.12	Level Switch- Conductivity Type for CRH drain pots consists of two nos of level probes, field mounted electronic control units-1 No., interconnecting cables 10 mtr	Nos	4	4
A.9.13	Coal Bunker Level Monitoring System - 3D Scanner on Bunker top, 2 Nos. Panel at Bunker Floor/Unit, 1 No. Computer in CER/Unit.	Set	8	8
A.9.14	I/P Converters for Burner Tilt & SADC	Nos	31	31
A.10.0	Erection of FLUE GAS ANALYZERS (Commissioning by OEM)			
A.10.1	High temperature Oxygen Analyzer (in situ type) make: SECO; Consisting of insitu, flange mounted zirconium oxide type probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	2	2

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.10.2	Low temperature Oxygen Analyzer (in situ type) make: AICPL; Consisting of insitu, flange mounted zirconium oxide type probe and electronics-1 cabinet, Auto Calibration unit for three calibration cylinders, Zero span and one span cylinders along with accessories, 2/1 metre probe protectors and wall mounted panel for Analyzer. App.weight of analyser is 22 Kg	Set	9	9
A.10.3	CO Analyser (In-Situ type) Consisting of CO Sensor head , High Temperature Probe (1800 mm app.), Protection tube (1800 mm app.), Temperature/Pressure Transmitters, Digital Display Unit, Air Dryer panel (App. size 760x760x210 mm), Power Supply Unit, Calibration Gas Cylinder filled with CO & Nitrogen, Pressure Switch for purge air blower, Air compressor-1 No. & connecting cables. App. weight of analyser is 22 kg.	Set	6	6
A.10.4	HF analyser Consists of Process & Purge tubes (1500 mm app.)-02 Nos, Transmitter/Receiver units-02 Nos, HF Gas Analyser Unit-01 No., Analyser Panel (App.Size 600x600x2000 mm)-01 No. (Wt. 200 kg), Air Purification unit-01 No., Power Supply unit-01 No., Canopies for Transmitter/Receiver/Power Supply unit (as applicable), Purge air unit-01 No., fail safe shutter with 10 mtr cable, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.	Set	1	1
A.10.5	Opacity Analyser (In Situ type) Consisting of Transceiver unit -02 No each with air purge connections, Signal processor unit, power supply unit, display control unit, fail safe shutter with 10 mtr cable against power or purge air failure, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.	Set	1	1

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.10.6	SOX/NOX/CO (Combined) 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 1915mm) 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). The probe is located at approx. 82 mt Elevation on chimney+ flue. Local PC based DAS consist of 24-inch monitor, i3 processor with key board and accessories.	Set	1	1
A.10.7	Mercury analyser consist of sample probe with heated filter, mounting flange, heated sample tubes with RTD (length 50 mtrs), span zero gas calibration cylinders, peristaltic pumps 2 nos, outdoor PLC panel size 1200mm(w) x 600mm (d) x 2000mm (h) aprox weight of panel 300 Kg, mounted on chimney at 41 mtr elevation.	Set	1	1
A.10.8	Gas Flow analyser (InSitu non-contact Cross duct type) Consisting of Transceiver unit -02 No each with air purge connections, Signal processor unit, power supply unit, display control unit, fail safe shutter with 10 mtr cable against power or purge air failure, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.	Set	1	1
A.11.0	STEAM AND WATER ANALYSIS (SWAS): The scope of work includes erection of main system along with the equipments and loose items indicated below, if any, interconnection pipes between cooler, chiller and wet panel, cooling water connection pipes between cooler, chiller and wet panel etc. Commissioning of the system by OEM.			

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.11.1	Sample Handling System: Sampling handling system consisting of: a. Primary Rack # 1: 01 Nos. Dim.1500(L)x800(D)x2100(H) in mm) App. overall weight 400 kg. b. Primary Rack # 2: 01 Nos. Dim.700(L)x800(D)x2000(H) in mm) App. overall weight 200 kg. c. Self Standing Racks # 3/4: 02 Nos. (App. Dim.600(L)x600(D)x1800(H) in mm) App. overall weight 150 kg. d. Wet panel:01 No.(App.Dim.5000 (L)x1600 (D)x2115(H) in mm) App.weight: 3000 kg. e. Analyser panel:01 No.(App. Dim.6500(L)x800(D)x2115(H) in mm) App. overall weight 2000 kg. f. Self Standing Rack (Sampling Skid) # 5: 01 Nos. (App. Dim.2500(L)x1500(D)x2200(H) in mm) App. overall weight 850 kg. g. Self Standing Racks # 6: 01 Nos. (App. Dim.800(L)x800(D)x2000(H) in mm) App. overall weight 200 kg. h. Chiller unit (redundant):01 No. (App. Dim 2200(L)x1200(D)x1275(H) in mm) and App. Overall weight: 850 kg.	Set	1	1
A.11.2	Sampling Sensors and Devices: The following analysers and sensors are to be assembled in the above said panels (or) as per the direction of BHEL Site engineer. a. Specific Conductivity Analysers: 08 Sets b. Cation Conductivity Analysers: 5 Sets c. pH Analysers: 10 Sets d. Dissolved O2 Analysers: 5 Sets e. Silica Analysers: 02 Sets f. Sodium Analysers: 01 Sets g. Chloride Analysers: 01 Set h. Turbidity Analysers: 01 Set i. Iron Analysers: 01 Sets j. Degassed Cation Conductivity Analyzers-02 Sets k. Hydrazine Analyser - 02 Sets	Set	1	1
A.11.3	A 106 Gr. 2" NB SCH 40 for Cooling water for SWAS includes Tees and bends	Mtrs	140	140
A.11.4	SS316, 2" NB SCH 40 for Cooling water for SWAS includes Tees and bends	Mtrs	60	60
A.11.5	Tubing with connectors (SS316 1/4" OD) Between wet and dry panel	Mtrs	420	420
A.11.6	Special cables for sensors between wet and dry panel	Mtrs	1100	1100

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.11.7	Laying and Termination of Power Cables to SWAS Panel/Chiller	Mtrs	50	50
A.12.0	Erection of VIBRATION MONITORING SYSTEMS-Commissioning by OEM			
A.12.1	Vibration Monitoring System for SG&TG at CER:			
A.12.1.1	Junction boxes	Nos	127	127
A.12.1.2	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	8	8
A.12.1.3	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	2	1
A.12.1.4	Three Bay VMS panel App. Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg.	Nos	1	1
A.12.1.5	VMS Server/User PC	Nos	2	2
A.12.1.6	Printer	Nos	1	1
A.12.1.7	Ethernet Cable	Mtrs	200	200
A.12.2	Vibration Monitoring System for CWP/ACWP at CWP Control Room:			
A.12.2.1	Junction boxes	Nos	37	37
A.12.2.2	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	2	2
A.12.2.3	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	1	1
A.12.2.4	FO Cable	Mtrs	1200	1200
A.12.2.5	Ethernet Cable	Mtrs	100	100
A.12.3	Vibration Monitoring System for APH Wash Pumps at Clarified Water Pump House and RW Pumps at RWPH Control Room:			
A.12.3.1	Junction boxes	Nos	49	0
A.12.3.2	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	6	0
A.12.3.3	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	2	0
A.12.3.4	FO Cable	Mtrs	6300	0
A.12.3.5	Ethernet Cable	Mtrs	100	0
A.13.0	Erection of UPS WITH ACDB & BATTERY BANK (Commissioning by OEM)			
A.13.1	Main Plant & St-I & II: 2 X180 KVA UPS parallel redundant comprising of the following: UPS-1 , UPS 2, Rectifier Panel, inverter panels and Aux panel 1,2 ,with Input also. Transformer overall size 6400 mm (L) x 1000 mm(W) x 2100 mm(H) aprox weight 8000 Kg. wall mounted Battery isolation JB's size 600mm x 300mm x800mm weight 80 Kg aprox. Wall mounted BHMS Display boxes aprox size 450mm x 500mm x 150mm and accessories.	Set	2	1
A.13.2	415 V ACDB of size app. 6400(L)x1000(W)x2100(H) in mm and app. Wt. 850 kg.	Nos	2	2

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.13.3	Laying of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) from UPS to Battery	Mtrs	600	600
A.13.4	Laying of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) UPS to ACDB	Mtrs	1200	1200
A.13.5	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	50
A.13.6	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	5460	5460
A.13.7	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	2
A.13.8	UPS BATTERY: 1285 AH/ 360 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 433(L) x 368(W) x 682(H). App.Cell weight without electrolyte: 134 Kg & 204 kg with electrolyte. Total Qty of electrolyte: 21000 litre.	Set	2	2
A.13.9	RWPH: 2 X10 KVA UPS parallel redundant comprising of thefollowing: UPS-1 , UPS 2, Rectifier Panel, inverterpanels and Aux panel 1,2 ,with Input Iso. Transformeroverall size 2200 mm (L) x 900 mm(W) x 1870 mm(H)aprox weight 3000 kg. wall mounted Battery isolation JBssize 600mm x 300mm x800mm weight 80 Kg aprox. Wallmounted BHMS Display boxes aprox size 450mm x 500mmx 150mm and accessories.	Set	1	0
A.13.10	415 V ACDB of size app. 750(L)x300(W)x1250(H) in mm and app. Wt. 200 kg.	Nos	2	0
A.13.11	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Mtrs	160	0
A.13.12	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Mtrs	60	0
A.13.13	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	0
A.13.14	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	3360	0
A.13.15	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	0

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.13.16	UPS BATTERY: 200 AH/ 220 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 134(L) x 203(W) x 406(H). App.Cell weight without electrolyte: 13.5 Kg & 21 kg with electrolyte. Total Qty of electrolyte: 1600 litre.	Set	1	0
A.13.17	Power Distribution Boards for BOP Plant App.Dimension 400(L)x300(W)x600(H) and app. Wt. 500 kg.	Nos	2	0
A.13.18	E&C of SMALL UPS SYSTEM			
A.13.18.1	1 kVA UPS System 230 V output, 30-90 min back up with 2/3 pin power socket with auto voltage regulator	Nos	5	0
A.14.0	LOCAL INSTRUMENT ENCLOSURES/RACKS			
A.14.1	Local Instrument Enclosures (Type - A)-Size: 1450(W) x 1000(D) x 2200 (H)mm; Approximate weight: 900 kg each	Set	20	20
A.14.2	Local Instrument Enclosures (Type - B)-Size: 1100(W) x 1000(D) x 2200 (H)mm; Approximate weight: 600 kg each	Set	36	36
A.14.3	Local Instrument Enclosures (Type - C)-Size: 700(W) x 1000(D) x 2200 (H)mm; Approximate weight: 400 kg each	Set	20	20
A.14.4	Local Instrument Racks (Type - A)-Size: 1400(W) x 650(D) x 2200(H) mm; Approximate weight: 600 kg each	Set	24	24
A.14.5	Local Instrument Racks (Type - B)-Size: 1100(W) x 650(D) x 2200(H) mm; Approximate weight: 400 kg each	Set	42	42
A.14.6	Local Instrument Racks (Type - C)-Size: 800(W) x 650(D) x 1500(H) mm; Approximate weight: 250 kg each	Set	18	18
A.14.7	Local Instrument Racks (Type - D)-Size: 1600(W) x 650(D) x 2200(H) mm; Approximate weight: 700 kg each	Set	6	6
A.15.0	LAYING AND TERMINATION OF CABLES			
A.15.1	Thermocouple Extension Cables			
A.15.1.1	2 Pair, 16 AWG, KX Type TC Extension Cable	Mtrs	10620	10620
A.15.1.2	6 Pair, 16 AWG, KX Type TC Extension Cable	Mtrs	29295	29295
A.15.1.3	2 Pair, 16 AWG, RX Type TC Extension Cable	Mtrs	2000	2000
A.15.2	Extruded HRPVC with FRLS, Armoured, Over All Shielded, Copper Cables			
A.15.2.1	2 pair x 0.5 sqmm	Mtrs	9270	9270
A.15.2.2	4 pair x 0.5 sqmm	Mtrs	25290	25290
A.15.2.3	8 pair x 0.5 sqmm	Mtrs	14535	13770

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.15.3	Extruded HRPVC with FRLS, Armoured, Individually and overall shielded, Copper Cables			
A.15.3.1	2 pair x 0.5 sqmm	Mtrs	11970	10890
A.15.3.2	4 pair x 0.5 sqmm	Mtrs	37877	36527
A.15.3.3	6 pair x 0.5 sqmm	Mtrs	600	600
A.15.3.4	8 pair x 0.5 sqmm	Mtrs	8055	8055
A.15.3.5	12 pair x 0.5 sqmm	Mtrs	2000	2000
A.15.3.6	2 Troid x 0.5 sqmm	Mtrs	11677	11677
A.15.4	Extruded HRPVC with FRLS, Armoured, Copper control Cables			
A.15.4.1	3 C x 2.5 sqmm	Mtrs	6615	2520
A.15.4.2	5 C x 2.5 sqmm	Mtrs	3330	3330
A.15.5	TG Special Cables			
A.15.5.1	Special Cable 5 x1.5 sqmm	Mtrs	1000	1000
A.15.5.2	FEP Insulated 2x2x0.5 sqmm type-1 Cable	Mtrs	5400	5400
A.15.5.3	FEP Insulated 2x4x0.5 sqmm type-2 Cable	Mtrs	2000	2000
A.15.5.4	CAT 6/Ethernet UTP Cable	Mtrs	17700	12200
A.15.5.5	Laying of Optic Fiber cable for offsite PLC/ DCS systems and MIS connectivity	Mtrs	30000	10000
A.15.5.6	HDPE Conduits for laying OFC cables	Mtrs	6000	6000
A.15.5.7	Splicing of Optical Fibre Cable	Nos	350	200
A.16.0	Installation of CABLE TRAYS			
A.16.1	50 mm Perforated Trays with Cover	Mtrs	1500	1500
A.16.2	100 mm Perforated Trays with Cover	Mtrs	1500	1500
A.16.3	50 mm Perforated Trays without Cover	Mtrs	2000	2000
A.16.4	100 mm Perforated Trays without Cover	Mtrs	2000	2000
A.17.0	E&C of JUNCTION BOXES			
A.17.1	12 way JB	Nos	16	16
A.17.2	24 way JB	Nos	54	54
A.17.3	36 way JB	Nos	30	30
A.17.4	48 way JB	Nos	22	22
A.17.5	64 way JB	Nos	5	5
A.17.6	72 way JB	Nos	2	2
A.17.7	96 way JB	Nos	6	6
A.17.8	128 way JB	Nos	5	5
A.18.0	E&C of IMPULSE PIPES, FITTINGS, MANIFOLDS AND ACCESSORIES.			
A.18.1	ASTM A335 P91 - 1/2" NB 160	Mtrs	1000	1000
A.18.2	ASTM A106 Gr C - 1/2" NB SCH 160	Mtrs	2800	2800
A.18.3	ASTM A106 Gr C - 1/2" NB SCH 80	Mtrs	9500	9500
A.18.4	ASTM A106 Gr C - 1" NB SCH 80	Mtrs	300	300
A.18.5	ASTM A106 Gr C - 3/4" NB SCH 80	Mtrs	7600	7600
A.18.6	ASTM A335 P22 - 3/4" NB SCH 80	Mtrs	1200	1200
A.18.7	ASTM A312 TP316- 1/2" NB SCH 40	Mtrs	280	280
A.18.8	ASTM A312 TP316H - 1/2" NB SCH 80	Mtrs	700	700
A.18.9	ASTM A312 TP316H - 1/2" NB SCH 160	Mtrs	1100	1100

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.19.0	E&C of INSTRUMENT VALVES AND ACCESSORIES			
A.19.1	FGV A105 :1/2" NB-SW 800	Nos	7	7
A.19.2	FGV ASTM A182 F91 :1/2"NB-SW 3000SPL	Nos	5	5
A.19.3	FGV ASTM A182 F22 :1/2"NB-SW, CL-1500	Nos	11	11
A.20.0	ERECTION OF MASTER AND SLAVE CLOCK SYSTEM (Commissioning by OEM)			
A.20.1	Reduntant GPS Based Master Clock System (Card Rack System) along with Fully wired Master clock System Panel (App.Size: 800 x 800 x 2415 mm; wt. 300 kg) - 01 No., power supply unit, battery system, signal boosters, Signal Conditioners, multiplexer, FO Accessories (LIU, Duplex etc.)	Set	1	0
A.20.2	42 U Panel of size 800 mm (L)x1000mm(W)x2115(H)for housing the servers, network switches	Nos	1	0
A.20.3	Slave clock (Rs 485 based)/NTP based Approximate Size: 750(W) x56(D) x 170(H) mm for various locations	Nos	45	0
A.20.4	Reduntant GPS antenna (built in LA) along with around 200 Mtrs antenna cable from antenna to GPS receiver unit and antenna fixing accessories.	Set	2	0
A.20.5	Reduntant GPS Receiver/Master Clock-A and Master Clock-B with comparator and out put cards.	Set	1	0
A.20.6	Laying and termination of RG 58 Coaxial Cable FRLS armoured (Clock panel to IRIG B interfacing equipment and Clock panel to various pulses interfacing equipments)	Mtrs	7500	0
A.20.7	Laying and termination of Armoured Power Cable 3Cx2.5 sqmm	Mtrs	6300	0
A.20.8	Laying and termination of Armoured Signal Cable 2Px0.5 sqmm	Mtrs	9000	0
A.20.9	Cable - CAT 5e/CAT6 for NTP / SNTP output	Mtrs	560	0
A.20.10	FO Cable (4F) connecting FO NTP outpus multimode armoured cable	Mtrs	5000	0
A.20.11	Splicing of Optical Fibre Cable	Nos	10	0
A.20.12	Flexible GI conduit Pipe	Mtrs	500	0
A.20.13	Junction Boxes	Nos	12	0
A.21.0	E&C of LARGE VIDEO SCREEN SYSTEMS			
A.21.1	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height / arrangement etc. in Unit Control room	Set	8	5

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.21.2	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for AHP system.	Set	4	0
A.21.3	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for CHP system.	Set	4	0
A.22.0	HMI & PIS SYSTEM PACKAGE			
A.22.1	HMIPIIS for Unit DDCMIS			
A.22.1.1	Operator WorkStation	Nos	25	10
A.22.1.2	Historical Storage & Retrieval (Information) WorkStation	Nos	2	2
A.22.1.3	Programmer cum documentation station	Nos	2	2
A.22.1.4	LaserJet Colour Printer (A4 size)	Nos	3	3
A.22.1.5	LaserJet B/W Printer (A4 size)	Nos	3	3
A.22.2	HMIPIIS for AHP DDCMIS			
A.22.2.1	Operator WorkStation	Nos	2	0
A.22.2.2	Programmer cum documentation station	Nos	2	0
A.22.2.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.3	HMIPIIS for CHP DDCMIS			
A.22.3.1	Operator WorkStation	Nos	2	0
A.22.3.2	Programmer cum documentation station	Nos	2	0
A.22.3.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.4	HMIPIIS for Mill Reject System			
A.22.4.1	Operator WorkStation	Nos	1	0
A.22.4.2	Programmer cum documentation station	Nos	1	0
A.22.4.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.5	HMIPIIS for CW/ACW SYSTEM			
A.22.5.1	Operator WorkStation	Nos	3	0
A.22.5.2	Programmer cum documentation station	Nos	3	0
A.22.5.3	LaserJet Colour Printer (A4 size)	Nos	3	0
A.22.6	HMIPIIS for Compressed Air System			
A.22.6.1	Operator WorkStation	Nos	1	0
A.22.6.2	Programmer cum documentation station	Nos	1	0
A.22.6.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.23.0	Performance Analysis Diagnostics and Optimization (PADO) Package			
A.23.1	Computer Table	Set	3	3
A.23.2	Chairs	Set	3	3
A.23.3	Printer Table	Set	1	1

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.24.0	LAB INSTRUMENTS - To be demonstrated and handing over to Customer			
A.24.1	Lab Instruments-I: Mecahnical Under the Supervision of OEM			
A.24.1.1	Dead Weight Tester - 2 Nos, Standard Quality Pressure Gauges - 3 Set, Laboratory Type Manometer - 2 Set, Inclined Tube Manometer - 2 Set, Manometer - 2 Set, Pressure and Vaccumm Air Pump - 2 Set, Portable Pressure Comparator - 1 Set, Temperature Calibration Bath - 1 Nos, Temperature Calibrator - 3 Nos, Temperature Calibrator (Table Mounted) - 2 Nos, Hot air Blower - 1 Nos, Barometers - 1 Nos, Surface Pyrometer - 1 Nos, Pneumatic Test Bench - 2 Nos, Portable Flue Gas Analyser - 1 Set, Furnace - 1 Nos, Mercury Thermometer - 2 Set, Tool Kit Box - 12 Nos, Oil Condition Monitor - 1 Nos, Portable Ultrasonic Flowmeter - 2 Nos, Wet & Dry Bulp Hygrometer - 1 Nos, Flowmeter Calibration - 1 Set, Air Sets - 1 Nos, Welding Machine - 1 Nos, Jewellers Lathe - 1 Nos, Grinding Machine - 1 Set, Feeler Gauge - 1 Nos, Anemometer (Portable) - 1 Nos, Stop Watch - 1 Nos, Vibration Calibrator - 1 Nos, Precision Instrument Radial Drilling Machine - 3 Nos, Portable Drilling Machine - 1 Nos, Universal Digital Thermometer - 1 Nos, Low and Medium Pressure Controller - 1 Set, Portable Pneumatic Hydraulic Calibrator - 1 Set, Bench Vice & Hand Vice - 3 Set, Vacuum Cleaner - 1 Nos, Screw Gauge - 1 Nos, Pitot Tube - 2 Nos, Test Thermocouple - 2 Nos.	Set	1	0
A.24.2	Lab Instruments-II			

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.24.2.1	Portable Multifunction Calibrator (Microprocessor based) - 3 Nos, Decade Resistance Box - 2 Nos, AC Universal Bridge - 1 Nos, Signal Generator - 2 Nos, Hand Tachometer - 2 Nos, Insulation tester of Different range - 1 Nos, DC Regulated Power Supply - 4 Nos, Stop Watch (Digital Type) - 2 Nos, Continuity Tester - 10 Nos, Tong Tester - 3 Nos, High Range Tong Tester - 1 Nos, Stabilised Power Supply - 2 Nos, Stroboscope - 1 Nos, Portable Trend Recorder - 1 Nos, Electronic Test Bench with computerized calibration system - 2 Nos, Digital Oscilloscope - 2 Nos, Decade Resistance Box - 2 Nos, Digital Multimeter - 2 Nos, Function Generator - 2 Nos, Chartless Recorder - 2 Nos, Variable DC Stabilized Power Supply - 2 Nos, Variable AC Stabilized Power Supply (0-260 V, 10A) - 2 Nos, Step Down Transformer (110V, 2A) - 2 Nos, Continuity Tester - 2 Nos, Fixed Power Supply (+/- 48 V DC, 3A, +/- 24V DC, 6A, +/- 12V DC, 10A, +/- 5V DC, 5A) - 2 Nos, Electronically Operated Air Gun - 2 Nos, Digital LCR-Q Bridge - 2 Nos, Card IC Tester - 2 Nos, Soldering Station & Desoldering Station - 2 Nos, Power meter with Harmonic Analysis - 2 Nos, One set of tool box with screw driver set, Spanner, Plier Cutter - 2 Nos, Portable digital multimeter - 10 Nos, Field Transmitter Calibrator - 2 Nos, Soldering Iron with Solder Sucker - 8 Nos, DE Soldering Station - 1 Nos, VARIAC - 1 Nos, Power Pack - 2 Nos, Vibration Analyzer Balancer Instrument - 2 Nos, Portable Meter Calibrator - 2 Nos, Digital Cable Identification System - 6 Nos, Dual Beam Portable Digital Storage Oscilloscope - 2 Nos, Hand Held Thermocouple and PT-100 Ohm Simulator and Indicator - 1 Nos, Insertion and Extraction tools for various Pin Numbers 14,16 and 48 - 2 Nos, Rheostats - 1 Nos, Desktop Digital Multimeter - 2 Nos, Phase Sequence Meter - 1 Nos, Frequency Meter - 1 Nos, Mini Scope Meter - 1 Nos, Vibration Meter Sould Level Monitor - 1 Nos, Portable pH Calibrator - 2 Nos, Module Tester - 1 Nos, DC Regulated Power Source - 2 Nos, Auto Transformer - 1 Nos, Nickel Cadmium Cell - 1 Nos, Scanner - 1 Nos, Torximitor - 2 Nos, Laptop - 2 Nos, Portable mA Calibrator - 3 Nos, Table Mounted mA Calibrator - 2 Nos, Portable mV Calibrator - 2 Nos, Test RTD - 2 Nos, Frequency counter/Timer - 1 Nos.	Set	1	0

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.25.0	COMPUTER FURNITURES-HANDLING & TRANSPORTATION TO THE LOCATION- ASSEMBLY REQUIRED FOR OF CONTROL DESKS/UNIT OPERATOR DESKS WILL BE DONE BY OEM			
A.25.1	Unit Operator Desk (8 Section) Angular installation dimension 7960mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	1
A.25.2	Common Operator Desk (8 Section) Straight installation dimension 7600mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.25.3	CWPH Operator Desk (3 Section) Straight installation dimension 2850mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.25.4	Common & other area Operator Desk (2 Section) Straight installation dimension 1900mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	6	0
A.25.5	Computer tables with Shelf for each Unit 1000mm(L)X1650MM(H)X950MM(D)	Set	31	31
A.25.6	Computer tables with Shelf for Common & Other areas 1000mm(L)X1650MM(H)X950MM(D)	Set	5	0
A.25.7	Computer tables with Shelf for common areas 1000mm(L)X1650MM(H)X950MM(D)	Set	12	0
A.25.8	Computer tables with Shelf for MIS Clients 1000mm(L)X1650MM(H)X950MM(D)	Set	40	40
A.25.9	Computer tables without Shelf 1000mm(L)x750mm(H)x1050mm(D)	Set	2	2
A.25.10	PC Rack 1000mm(L)x1900mm(H)x900mm(D) including fixing of power sockets, MCBs, Ethernet Switches hardware, etc	Set	2	2
A.25.11	Printer Tables 735mmx900mmx600mm including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	13	13
A.25.12	Printer Tables 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	9	0
A.25.13	Printer Tables for MIS Clients 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	40	40
A.25.14	Printer Tables for MIS Servers 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	2	2

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A.25.15	Computer Chair Medium back with cushioned arms	Set	85	55
A.25.16	Computer Chair Medium back with cushioned arms for MIS Clients	Set	40	40
A.25.17	Almira 1780mm x 839mm x 380mm with glass window	Set	1	1
A.25.18	Safety lock key pad 350mm x 250mm x 250mm weight 10 kg, safety rack 1830mm x 410mm x 457mm	Set	1	1
A.25.19	Operator Desk (6 Section) Straight installation dimension 5700mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.26.0	TERMINATION OF POWER CABLES			
A.26.1	Termination of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) from UPS to Battery	Nos	14	14
A.26.2	Termination of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) UPS to ACDB	Nos	26	26
A.26.3	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Nos	4	0
A.26.4	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Nos	2	0
A.27.0	COMMISSIONING OF THE FOLLOWING			
A.27.1	Commissioning of Transducers- Removal and recalibration of Power, Voltage, Current, Frequency out put 4-20 mA	Nos	25	25
A.28.0	STRUCTURAL MATERIALS			
A.28.1	ISMC 100, ANGLE 50X50X6 & 2.5MM THICK Plates	MT	15	15
A.28.2	Duct Tray - 60x60x1000 mm	Mtrs	108	108
A.28.3	Duct Tray - 180x100x1000 mm	Mtrs	73	73
A.28.4	Duct Tray - 250x100x1000 mm	Mtrs	90	90
A.28.5	Assembly and Installation of Mounting frames with loose supplied prefabricated materials like slotted angles, channels, etc.	Nos	10	10
A.28.6	Fire protection switches & Emergency Push Buttons	Nos	8	8
B	BHEL TRICHY SCOPE OF SUPPLY			
B.1.0	FUEL OIL SYSTEM			
B.1.1	PD Type Mass flow meter in HFO,LDO/HSD & HFO return line with mounting flanges, electronics amplifier box, inter connecting cabling, etc.	Set	3	3
B.1.2	Pressure Gauges	Nos	72	45
B.1.3	Temperature Indicator	Nos	12	6
B.1.4	Pressure Switches	Nos	22	22
B.1.5	Level Indicator	Nos	1	1

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.1.6	Temperature Elements	Nos	2	0
B.1.7	FSSS Local Oil Gun Maintenance Switch Box	Nos	18	18
B.1.8	H.E.A Exciter box 240 V AC alongwith retractor assembly 240 V AC solenoid, flexible spark rod 133 inch, spark top, flexible cable assembly 3 mtr long, SS hose 6.35mmx1000mmm, Air Filter Regulator 1/4 inch etc.	Set	16	16
B.1.9	Flame Scanner Head Assembly consisting fibre optic cable L130" lense barrel, flame processor module, Flame module, pigtail cable, pico fuse, card extender module, power supply module, 6 way JB, etc	Set	32	32
B.1.10	Microprocessor based flame scanner amplifier of 19" racks of size 482x263x134 (WxDxH) to be mounted in flame scanner panel (CJF49/CJF50) supplied by EDN	Set	8	8
B.2.0	ACOUSTIC STEAM LEAK DETECTOR			
B.2.1	ASLD panel assembly and computer with monitor panel size 800mmx2315mmx800mm & App.Wt. 200 kg	Set	1	1
B.2.2	ASLD sensor assembly -30 Nos + Sonic Tube + Field Amplifier box with Module- 32 Set+ Power Supply Units-4 Nos+ JB- 1No, Calibrator-1 No, Sensor Pig tail cable-450 mtr	Set	1	1
B.3.0	FURNACE CCTV SYSTEM			
B.3.1	High Temperature Furnace Camera CCTV head assembly with advance retract mechanism and Local Control Unit panels (800mmx1000mmx300mm) with inter connecting pipes, air filter regulators, ss hose mounted at boiler 45 M elevation. Remote Control Box (600 mm x500 mmx 300 mm) with 24" monitor and accessories at CCR, 40" LED monitor & Multiplexer.	Set	2	2
B.4.0	PNEUMATIC POWER CYLINDERS (REGULATING TYPE) Installation and Commissioning			
B.4.1	Pneumatic Power Cylinders with Position Transmitters controlled from SADC (App.Weight 20 kg each)	Set	132	132
B.4.2	Pneumatic Power Cylinders with SMART Positioners controlled from DDCMIS (App.Weight 20 kg each)	Set	16	16
B.4.3	PA/ID/FD Fans Blade Pitch Control Damper with SMART Positioner controlled from DDCMIS (App.Wt. 90 kg)	Set	6	6
B.4.4	Cold Air Regulating Dampers with SMART positioner alongwith linkage rod (App.Wt. 95 kg)	Set	8	8
B.4.5	Hot Air Regulating Dampers with SMART positioner alongwith linkage rod (App.Wt. 175 kg)	Set	8	8

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.4.6	Dynavane Filter Pressure Control Damper with SMART positioner	Set	1	1
B.5.0	GRAVIMETRIC FEEDER PANEL			
B.5.1	Gravimetric Feeder Remote Power Cabinet Size 1200x2315x600 and Wt.300 kg	Nos	8	8
B.5.2	Feeder Coal flow monitor assembly flange mounted	Set	8	8
B.6.0	STEAM/WATER/PULVERIZER/AIR/FLUE GAS LINE INSTRUMENTS			
B.6.1	Pressure Indicators	Nos	15	15
B.6.2	DP Switches	Nos	1	1
B.6.3	Temperature Indicator	Nos	8	8
B.6.4	K-Type MTM Thermocouple 8MM OD & 8 M DUPLEX	Nos	8	8
B.6.5	K-Type MTM Thermocouple 8MM OD & 10 M DUPLEX	Nos	33	33
B.6.6	K-Type MTM Thermocouple 8MM OD & 12 M DUPLEX	Nos	38	38
B.6.7	K-Type MTM Thermocouple 8MM OD & 14 M DUPLEX	Nos	41	41
B.6.8	K-Type MTM Thermocouple 8MM OD & 16 M DUPLEX	Nos	37	37
B.6.9	K-Type MTM Thermocouple 8MM OD & 18 M DUPLEX	Nos	40	40
B.6.10	K-Type MTM Thermocouple 8MM OD & 20 M DUPLEX	Nos	63	63
B.6.11	K-Type MTM Thermocouple 8MM OD & 22 M DUPLEX	Nos	57	57
B.6.12	K-Type MTM Thermocouple 8MM OD & 24 M DUPLEX	Nos	47	47
B.6.13	K-Type MTM Thermocouple 8MM OD & 26 M DUPLEX	Nos	57	57
B.6.14	K-Type MTM Thermocouple 8MM OD & 28 M DUPLEX	Nos	16	16
B.6.15	K-Type MTM Thermocouple 8MM OD & 30 M DUPLEX	Nos	12	12
B.6.16	DP Switches	Nos	2	2
B.6.17	Level Switches High/Low	Nos	20	20
B.6.18	DP Switches High/Low	Nos	17	17
B.6.19	ERV Controller with Pressure Switch App.Dimension(mm): 400x350x190; App.Wt: 10 kg	Set	4	4
B.7.0	LAYING AND TERMINATION OF CABLES (PVC,FRLS,ARMOURED CABLES FOR SCANNER, MILL FEEDER, AC CONTROLS AND INSTRUMENTATION)			
B.7.1	FLAME SCANNER CABLE-P/O SHIELDED	Mtrs	8280	8280
B.7.2	2P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	1500	1500
B.7.3	4P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	4950	4950

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.7.4	8P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	32400	32400
B.7.5	12P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	5850	5850
B.7.6	2P X 1.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	9900	9900
B.7.7	2P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	3150	3150
B.7.8	4P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	8820	8820
B.7.9	8P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	7200	7200
B.7.10	12P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	4320	4320
B.7.11	3C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	500	500
B.7.12	5C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	500	500
B.7.13	7C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.14	9CX 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.15	12CX 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.16	12P X 1.31 SQ. MM. EXTN. CABLE - KX	Mtrs	2700	2700
B.7.17	2P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2700	2700
B.7.18	4P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2880	2880
B.7.19	8P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2000	2000
B.7.20	4P X 0.5 SQ.MM PTFE INST. CABLE - F	Mtrs	750	750
B.7.21	3C X 2.5 SQ.MM PTFE CONTROL CABLE	Mtrs	550	550
B.7.22	5C X 2.5 SQ.MM PTFE CONTROL CABLE	Mtrs	2000	2000
B.7.23	2P X 0.5 SQ.MM PTFE INST. CABLE - F	Mtrs	2600	2600
B.7.24	2P X 1.31 SQ.MM PTFE EXTENSION CABLE	Mtrs	3600	3600
B.8.0	CABLE TRAY			
B.8.1	CABLE TRAY-50 MM WIDTH	Mtrs	1750	1750
B.8.2	CABLE TRAY-100 MM WIDTH	Mtrs	5875	5875
B.8.3	CABLE TRAY-150 MM WIDTH	Mtrs	3750	3750
B.9.0	JUNCTION BOXES			
B.9.1	24 WAY FRP JUNCTION BOX WITH CANOPY	Nos	80	80
B.9.2	48 WAY FRP JUNCTION BOX WITH CANOPY	Nos	65	65
B.9.3	72 WAY FRP JUNCTION BOX WITH CANOPY	Nos	60	60
B.9.4	24 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	5	5
B.9.5	48 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	35	35
B.9.6	72 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	10	10
B.10.0	MISCELLENEOUS RACKS/PANELS			
B.10.1	Local Instrument Enclosures/Racks with Junction Boxes, App. Size: 1650x2150x800 (mm) and App.Wt: 500 kg	Set	15	15
B.10.2	Pulveriser Dynamic Classifier - VFD Cabinet App. Size: 900x2100x700 (mm) and App.Wt: 100 kg	Nos	8	8
B.10.3	HWL-1&2 and MEF Controller JB App. Size: 600x600x250 (mm) and App.Wt: 50 kg	Nos	3	3
B.10.4	HWL-1&2 and MEFCV - Skid Instrumentation	Set	1	1
B.10.5	HP Bypass Valve - Skid Instrumentation	Set	1	1
B.11.0	HARDWARES FOR TUBING			

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.11.1	TUBES			
B.11.1.1	1/4" Air Filter Regulators (for mill system)	Nos	8	8
B.11.1.2	1" Air Filter Regulators (for SADC System)	Nos	8	8
B.11.1.3	Purge Meter cum DP Regulator	Nos	16	16
B.11.1.4	1" OD SS TUBE	Mtrs	40	40
B.11.1.5	1/4" OD SS TUBE	Mtrs	4800	4800
B.11.1.6	3/4" OD SS TUBE	Mtrs	20	20
B.11.1.7	3/8" OD SS TUBE	Mtrs	55	55
B.11.1.8	1/4" TEFLON HOSE- 2 METER PER PIECE	Nos	135	135
B.11.1.9	1" TEFLON HOSE- 3 METER PER PIECE	Nos	5	5
B.11.1.10	1/2" TEFLON HOSE- 1 METER PER PIECE	Nos	18	18
B.11.2	SEAMLESS PIPES			
B.11.2.1	Seamless Pipe-Matl : SA335P91-Size: 1/2" Sch XXS	Mtrs	65	65
B.11.2.2	Seamless Pipe-Matl : SA335P22-Size: 1/2" Sch 80	Mtrs	125	125
B.11.2.3	Seamless Pipe-Matl : SA335P22-Size: 3/4" Sch 80	Mtrs	200	200
B.11.2.4	Seamless Pipe-Matl : SA335P22-Size: 3/4" Sch 80	Mtrs	220	220
B.11.2.5	Seamless Pipe-Matl : SA106Gr B-Size: 3/4" Sch 80	Mtrs	850	850
B.11.2.6	Seamless Pipe-Matl : SA106Gr B-Size: 3/4" Sch 80	Mtrs	165	165
B.11.2.7	Seamless Pipe-Matl : SA106Gr B-Size: 1" Sch 80	Mtrs	1050	1050
B.12.0	MISCELLENEOUS ITEMS			
B.12.1	Structural Steel for fabrication of Supports consisting of angles, channels (ISA ISMC 100x50x6 wt 1250 kg, ISA 50x50x6 Wt. 800 kg,etc)	MT	2	2
B.12.2	1/2" GI Pipe	Mtrs	1215	1215
B.13.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
B.13.1	Heavy Duty Limit Switches for Burner Tilt Shear Pin Failure Indication Purpose	Nos	32	32
B.13.2	HWL 1 & 2 & MEFCV Motor Starter Panel	Set	1	1
B.13.3	Motor Operated Valves (MOV) Actuators (On/Off) in Various Applications	Nos	78	78
B.13.4	Motor Operated Valves Actuators (MOV) (inching) in Various Applications	Nos	35	35
B.13.5	Electric Actuators for Various Dampers (Open/Close)	Nos	16	16
B.13.6	Pneumatic Actuators for Various Dampers(Open/Close)	Nos	17	17
B.13.7	Limit Switches (Cabling and Checking) for manually operated dampers	Nos	44	44
B.13.8	Solenoids (different ratings) of Pneumatic Valves of Various applications - tubing, Cabling & Commissioning	Nos	213	213

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.13.9	Burner Tilt Shear Pin failure indication junction box App.Dimension: 280(H)x600(L)x200(D): weight 12 kg each	Nos	16	16
B.13.10	Calibration/Commissioning of Gravimetric Feeder Comprising of Feeder C&I Equipment like motion monitor sensor, micro switches, etc. along with Feeder Integral Cabinet of App.Size 600x750x350 and Wt.75 kg , LT Motors, etc.	Set	8	8
B.14	SCR PACKAGE			
B.14.1	INSTRUMENTS			
B.14.1.1	Pressure Indicators	Nos	14	3
B.14.1.2	Level Switches H/HH	Nos	10	6
B.14.1.3	Level Transmitters	Nos	12	6
B.14.1.4	Differential Pressure Transmitters	Nos	10	8
B.14.1.5	Pressure Transmitters	Nos	51	25
B.14.1.6	Temperature Elements	Nos	44	28
B.14.1.7	Temperature Indicator	Nos	6	3
B.14.1.8	Ammonia Leak Detector	Nos	10	4
B.14.1.9	Density Analyzer	Nos	2	2
B.14.1.10	pH Analyzer	Nos	1	1
B.14.1.11	Oxygen Analyzer: Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	4	4
B.14.1.12	NoX Analyzer: Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	6	6
B.14.1.13	SoX Analyzer:Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	4	4
B.14.1.14	NH3 Analyzer:Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	2	2

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.14.1.15	Flow Elements	Nos	14	14
B.14.1.16	Flow Transmitters	Nos	20	20
B.14.2	CABLES			
B.14.2.1	4P X 0.5 SQ.MM. O/A SHIELDED INST. CABLE	Mtrs	7200	7200
B.14.2.2	8P X 0.5 SQ.MM. O/A SHIELDED INST. CABLE	Mtrs	5400	5400
B.14.2.3	12P X 0.5 SQ.MM O/A SHIELDED INST. CABLE	Mtrs	900	900
B.14.2.4	2P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	2200	2200
B.14.2.5	4P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	7200	7200
B.14.2.6	8P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	5760	5760
B.14.2.7	3C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	2430	2430
B.14.2.8	5C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	8100	8100
B.14.2.9	9C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	1500	1500
B.14.2.10	12C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	5400	5400
B.14.2.11	2P X 1.31 MM ² EXTENSION CABLE - KX	Mtrs	100	100
B.14.2.12	4P X 1.31 MM ² EXTENSION CABLE - KX	Mtrs	800	800
B.14.3	JUNCTION BOXES			
B.14.3.1	24 WAY JUNCTION BOX	Nos	12	12
B.14.3.2	48 WAY JUNCTION BOX	Nos	17	17
B.14.3.3	24 WAY JUNCTION BOX-FLAME PROOF	Nos	10	10
B.14.3.4	48 WAY JUNCTION BOX-FLAME PROOF	Nos	10	10
B.14.3.5	72 WAY JUNCTION BOX-FLAME PROOF	Nos	6	6
B.14.4	PUSHBUTTON STATIONS			
B.14.4.1	E-STOP PUSH BUTTON STATION	Nos	10	10
B.14.4.2	FOGGING PUSH BUTTON STATION	Nos	5	5
B.14.5	CABLE TRAYS			
B.14.5.1	Cable Trays - 50mm Perforated with accessories	Mtrs	250	250
B.14.5.2	Cable Trays - 100mm Perforated with accessories	Mtrs	125	125
B.14.6	MISCELLANEOUS RACKS/PANELS			
B.14.6.1	Local Instrument Enclosures/Racks with Junction Boxes, App. Size: 1650x2150x800 (mm) and App.Wt: 1000 kg	Set	7	7
B.14.7	SUPPORTING MATERIALS			
B.14.7.1	ANGLE (50X50X6)/CHANNEL(100X50)	MT	3	3
B.14.8	EARTHING MATERIALS			
B.14.8.1	Earth Flat (50x6)	Mtrs	125	125
B.14.8.2	Earth Wire 1.219 mm GI	Mtrs	350	350
B.14.9	IMPULSE TUBES			
B.14.9.1	IMPULSE TUBE OD 6.35X1.6X9500-SA213TP304H with accessories	Mtrs	320	320
B.14.10	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
B.14.10.1	Motor Operated Valve (MOV) Actuators (On/Off) in various locations	Nos	8	8
B.14.10.2	Motor Operated Valves Actuators (MOV) (Regulating) in Various Locations	Nos	1	1

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
B.14.10.3	Unit Directional Drives	Nos	19	19
B.14.10.4	Pneumatic Operated On/Off/Control Valves with accessories	Set	30	11
C	BHEL-PIPING CENTRE SCOPE OF SUPPLY			
C.1.0	Local Instruments			
C.1.1	Pressure Gauges	Nos	40	40
C.1.2	Temperature Gauges	Nos	104	104
C.1.3	Averaging Pitot Tube	Set	3	3
C.2.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
C.2.1	Control Valves - for LP Start Up Systems & SCAPH Sysyems - including Air Filter Regulators, Positioners, Testing upto DCS	Set	5	5
C.2.2	MOV Actuators for SCAPH, CW Aux Steam,etc	Nos	16	16
C.2.3	LT Drives: Condensate Drain Pumps, Emergency Fill Pumps	Nos	5	5
D	BHEL RANIPET SCOPE OF SUPPLY			
D.1	OPACITY MONITOR			
D.1.1	Opacity Monitoring System consisting of Sender/Receiver/Ref/Control Unit 1 No. each, 5 Metre Slave wire cable-1 No., Purge Air Blower with filter-1 No., Power JB-1 No., Weather Hood Cover for Purge Air Blower JB-1 No.Fully auto. Electric Operated Fail Safe Shutter-2 Nos., Differential Pressure Switch-2 Nos., Mounting Flange With Pipe - 2 Nos., Weather Hood Cover for Sender/Receiver Units - 2 Nos., Weather Hood Cover for Power JB-2 Nos. & Purge Air Hose	Set	4	4
D.2.0	AUTOMATIC LEAKAGE CONTROL SYSTEM-Air Pre Heater			
D.2.1	ALCS DCS panel 750x750x2067 mm. App. Wt.90 kg	Nos	1	1
D.2.2	ALCS Drive Control Panel 680x400x1053 mm App.Wt.50 kg	Nos	6	6
D.2.3	ALCS Controller with panel 370x210x520 mm App. Wt. 5 kg	Nos	6	6
D.2.4	Sensor Electronic with Enclosure 140x100x70 mm	Nos	6	6
D.2.5	Interfacing Box 140x100x70 mm App.Wt.5 kg.	Nos	6	6
D.2.6	Shielded Teflon Cable for ALCS	Mtrs	30	30
D.3.0	Instruments of APH/Fans/Gates & Dampers			
D.3.1	Pressure Switches	Nos	4	4
D.3.2	Pressure Indicators	Nos	24	24
D.3.3	RTD With Thermowell	Nos	8	8
D.3.4	Temperature Indicator	Nos	10	10
D.3.5	Flow Indicating Switch	Nos	4	4
D.3.6	Go Switch	Nos	2	2

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
D.3.7	Dial Thermometer	Nos	2	2
D.3.8	Temperature Elements	Nos	12	12
D.3.9	Thermocouple with Thermowell	Nos	56	56
D.3.10	On/Off Switch Box including light assembly and interconnecting heat resistant cable	Set	2	2
D.3.11	Temperature Indicators-Fans	Nos	24	24
D.3.12	RTDs with Thermowell-Fans	Nos	64	64
D.3.13	Pressure Gauges-Fans	Nos	2	2
D.3.14	Pressure Transmitters-Fans	Nos	2	2
D.3.15	Angular Position Transmitters-For FD/ID/PA Fans	Nos	6	6
D.3.16	Pressure Switches-GAD	Nos	10	10
D.4.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
D.4.1	Electric Actuators for Various Dampers (Open/Close)	Nos	76	76
D.4.2	Pneumatic Actuators for Various Dampers (Open/Close)	Nos	27	27
D.4.3	Solenoid Valves for APH	Nos	2	2
D.4.4	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 app. Quantity of instruments for each skids given below: Pressure Gauges-2 Nos. Temperature Gauges-2 Nos., Flow Switches-2 Nos.	Set	4	4
D.4.5	Fan Motor Bearing Temperature Indicators for all fans (Removal, Calibration and refixing only)	Nos	24	24
D.4.6	Fan Motor Bearing/Winding RTDs (Checking of healthiness only)	Nos	64	64
D.4.7	Lub Oil Skids for FD Fans: The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantity of instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Sensing Elements: -3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-01 No., Pr. Gauge-3 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 02 No.	Set	2	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
D.4.8	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 put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Elements - 3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-1No., Pr. Gauge-6 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 05 Nos.	Set	2	2
D.4.9	Lub Oil Skids for PA Fans: The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantity of instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Elements- 3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-1 No., Pr. Gauge-6 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 05 Nos.	Set	2	2
E	BHEL-HYDERABAD SCOPE OF SUPPLY			
E.1.0	DRIVE TURBINE INSTRUMENTS			
E.1.1	Pressure Gauges	Nos	54	54
E.1.2	Differential Pressure Gauges	Nos	6	6
E.1.3	Pressure Transmitters	Nos	78	78
E.1.4	Pressure Switches	Nos	4	4
E.1.5	RTDs with Thermowell	Nos	40	40
E.1.6	Chromel alumel Type Thermocouple	Nos	30	30
E.1.7	Level Transmitters (Guide Wave Radar Type, top mounted)	Nos	4	4
E.1.8	Speed Measuring Loop with probe	Nos	6	6
E.1.9	Proximeter Units, Local Field Cable etc. for Governing Sytem	Set	40	40
E.1.10	Position Transmitters	Nos	4	4
E.1.11	Temperature Gauges	Nos	40	40
E.2.0	DRIP PUMP/CWP/TDBFP/CEP INSTRUMENTS			
E.2.1	Temperature Elements (RTDs)	Nos	102	102
E.2.2	Thermowells	Nos	6	6
E.2.3	Solenoid Valves	Nos	5	5
E.3.0	PULVERISING SYSTEM – E&C			
E.3.1	Temperature Elements -Planetary Gear Box	Nos	48	48
E.3.2	Level Switches (Mill Seal Air)	Nos	8	8
E.3.3	Junction Boxes (48 Way)	Nos	16	16
E.3.4	Erection of MDV Solenoids with Manifolds and tubing	Set	8	8
E.4.0	HEAT EXCHANGERS (LP & HP Heaters) & DEAERATORS			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
E.4.1	Pressure Gauges	Nos	12	12
E.4.2	Level Switches	Nos	3	3
E.4.3	Thermowell	Nos	8	8
E.4.4	Bimetallic Temperature Gauges	Nos	6	6
E.5.0	Erection & Commissioning of PANEL/FIELD MOUNTED INSTRUMENTS (Supervision by OEM)			
E.5.1	TSI System for BFP Drive Turbine and gear box consisting of the following: Configuration of Laptop with software-1 No., Monitor Rack with Modules (to be mounted on CWW panel) app. Wt. 40 kg per rack-1 Set, relative shaft vibration sensor probes 8mm reverse mounted Turbine and gear box-8 Nos, Axial Displacement Probes-3 Nos., Eccentricity Probe-1 No., Zero Speed Probe - 1 No., Key phasor-1 No., Bearing housing vibration Probes-4 Nos., Differential Expn. Probe -1 No., Casing Expansion-1 No., with probe extension cables-18 Nos., Probe drivers for VIBR-17 Nos., Driver Housing -12 No., JB - 3 Nos., Flexible conduits-150 Mtr., Cable seal, Cable connectors, Mounting brackets for vibration/differential exp/brg housings, RS485 cable with connector for DCS 35 Mtr long etc and calibration kit.	Set	2	2
E.5.2	Fabrication of Local Instrument Racks, each of size 1500x1700mm with the following materials Channel (100x50mm), Angle (50x50x6mm), 4mm Thick Sheet (400x120mm) and 10mm Thick Plate (375x770mm).	MT	2	2
E.5.3	Temperature Indicators of BFP, CEP (Removal, Calibration & Refixing only)	Nos	8	8
E.6.0	LOCAL GAUGE BOARD (LGB) / LOCAL INSTRUMENT RACK (LIR) (including removal, calibration and re-fixing of LGB mounted instruments)/JB			
E.6.1	LGB (LGB -1)Assembly for Feed Water Service for TDBFP/MD BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1100 x900 x 2200 mm ; Weight = 600 kg each. Quantity of instruments per set is Pressure Gauge: 4 Nos.DP Gauges: 2 Nos.Temperature Gauges: 2 Nos.	Set	3	3

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
E.6.2	LGB (LGB-2) Assembly for SW & Cooling Water Service of TD/MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg each. Quantity of instruments per set is Temperature Gauges: 8 Nos. Pressure Gauge - 1 Nos. DP Gauges - 3	Set	3	3
E.6.3	LGB (LGB-2) Assembly for Lub oil service of TD / MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg each. Quantity of instruments per set is Temperature Gauges: 4 Nos. Pressure Gauge - 4 Nos.	Set	3	3
E.6.4	LGB (LGB-1) Assembly for 3 Nos. CEP instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Quantity of instruments per set is Pressure Gauges: 6 Nos..Diff. pressure Gauges: 3 Nos. temp. gauge qty 3 nos Approximate Size 1100 x 900 x 2200 mm; Weight = 600 kg each	Set	1	1
E.6.5	Local instrument rack (LIR) assembly for TDBFP/MD BFP Transmitters. This LIR includes PT & DPTs, tubing , fittings, JB's, Main-fold valves and wiring from JB's to transmitters. Approximate Size 2000 x 650 x 2150 mm; Weight = 350 kg. Quantity of instruments per set is DP transmitters: 05 Nos. Pressure transmitter : 05 Nos.	Set	3	3
E.6.6	Local Instrument Rack (LIR) assembly for CEP-A,B&C pumps to mount Pr. Transmitters. This LIR includes Transmitters, tubing, fittings, JB's, Manifolds Valves Approximate Size: 2000 x 600 x 2150 mm; and wiring from JB's to transmitters Weight = 300 kg Quantity of instruments per set is Pressure transmitters: 9 Nos, DP transmitters : qty 3 nos	Set	1	1
E.6.7	24 Terminals JB for Thrust Bearing RTDs	Nos	10	10
E.7.0	SUPPORT MATERIALS			
E.7.1	Structural steel (ISMC 100 x 50 mm qty 20 mtrs, Angle 45 x 45 x 5 mm-qty 24 mtrs etc.)	MT	0.5	0.5
E.7.2	Impulse Tube Dia 16X2.6 (CS) for BFP/CEPs	Mtrs	1900	1900
E.7.3	SS tube 12.7x2.1	Mtrs	750	750
E.7.4	SS tube 6x1.5	Mtrs	35	35
E.8.0	Cables/Cable Trays for BFP/CEPs			
E.8.1	4 Pair x 0.5 sqmm cable	Mtrs	500	500
E.8.2	Perforated Cable Tray 50 mm Wide	Mtrs	80	80
E.8.3	Perforated Cable Tray 150 mm Wide	Mtrs	45	45

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
E.9.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
E.9.1	Mills Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Transmitter-03 Nos., Temperature Elements-09 Nos., Temp.Gauges-02 Nos., DP Transmitters- 01 No., DP Indicator-01 No., Pressure Gauge-3 Nos., Pressure Transmitters- 03 Nos. and Flow Transmitter-06 Nos.	Set	8	8
E.9.2	LT Drives of Lub Oil Skid of Mills	Nos	16	16
E.9.3	Turbine Lub Oil Purification Skid: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Switch-02 Nos., Temperature Elements-02 Nos., Temp.Gauges-03 Nos., DPI with Switch- 01 No., Pressure Gauge-04 Nos.	Set	2	2
E.9.4	LT Drives of Oil Purification Skid of Turbine	Nos	2	2
E.9.5	Control Valves with Smart Positioner, AFR, Limit Switches, inbuilt Position Transmitters, Junction Box,etc	Set	8	8
E.9.6	LT Drives of TDBFP System	Nos	18	18
E.9.7	MOV Actuators for TDBFP System	Nos	26	26
E.9.8	LT Drives of MDBFP System	Nos	9	9
E.9.9	Hydraulic Coupling of MDBFP: The scope of work covers a) Removal, calibration & re-fixing of following instruments. Pressure Indicators: 2 Nos. DP Indicator: 1 No. Temperature Indicators: 14 Nos. Pressure Transmitters: 6 Nos. Level transmitter: 1 No. DP transmitter: 1 No. RTDs (Checking only): 18 Nos. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. C) Commissioning of Speed Indicators etc.	Set	1	1
E.9.10	Governing Console Board: The scope includes removal, calibration and re-fixing of Instruments, wiring etc. Size of panel 1200 x 1650 x 450 mm The approximate quantity of instruments is Pressure Gauges: 10 Nos. Pressure Switches: 24 Nos.	Set	2	2
E.9.11	Commissioning of Mill fire fighting and Burge Air Valves (Pneumatic Operated)	Set	16	16
E.9.12	Commissioning of Pneumatic Actuators of Mill Discharge Valves (MDV)	Set	40	40
F	VOID			
G	BHEL-HARIDWAR SCOPE OF SUPPLY			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
G.1.0	GENERATOR AUXILIARY CONTROL CABINETS- INSTALLATION AND COMMISSIONING			
G.1.1	Moisture Measurement System for Generator, including indicator cum controller placed in control room 144 x 72 and sampling system in field 760 x 600 x 210 . Weight : 100 Kg	Set	2	2
G.1.2	Gen end vibration monitoring cabinet (CXW01E) dimention 800mm(W) x 600mm (D) x 2200mm (H) Including preamplifier units, special cables interconnecting, PC based monitor and printer computer table etc.aprox weight 150 kg	Set	1	1
G.1.3	Grounding Brush Monitor (Wall mounted) Approx. size & weight : 235 x 235 x 285 mm; 100 Kg.	Set	1	1
G.1.4	H2 Gas Analyzer Cabinet 1000x600x2000 (mm). Weight : 450 kg	Set	2	2
G.2.0	INSTALLATION AND COMMISSIONING OF GENERATOR INSTRUMENTS:			
G.2.1	Thermocouples (NiCrNi) (Generator Bearing Temp: 4 Nos.& Exciter Bearing Temp: 2 Nos.)	Nos	6	6
G.3.0	REMOVAL, CALIBRATION & REFIXING OF GENERATOR INSTRUMENTS			
G.3.1	Checking the healthiness of the RTDs/Thermocouples	Nos	140	140
G.4.0	LAYING AND TERMINATION OF POWER CABLES FOR 24 V SOLENOIDS			
G.4.1	4Cx2.5 Sqmm	Mtrs	14400	14400
G.5.0	LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON GENERATOR PIPINGS			
G.5.1	Vacuum Switches	Nos	2	2
G.5.2	Pressure Gauges	Nos	4	4
G.5.3	Pressure Transmitters	Nos	3	3
G.5.4	PT RTD, Duplex Type	Nos	3	3
G.5.5	Dial Thermometer	Nos	3	3
G.5.6	Level Switches (capacitance type)	Nos	19	19
G.6.0	LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON H2 COOLER PIPINGS			
G.6.1	Pressure Gauges	Nos	8	8
G.6.2	Pressure Transmitter	Nos	1	1
G.6.3	PT RTD, Duplex Type	Nos	7	7
G.6.4	Dial Thermometer	Nos	6	6
G.7.0	TURBINE INSTRUMENTATION GAUGES AND SENSORS			
G.7.1	RTDs for Cooling Water for LP Bypass, MOT, Control fluid	Nos	6	6
G.7.2	Thermocouples (for MAV,LBA,LBB,LBG,PGB,MAW,MAA,MAB,MAN etc	Nos	80	80

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
G.7.3	Thermocouples routed alongwith innercasing as per drawing only installation and healthiness checking for TSE, IPC exhaust, LPC outer, LPC-2 outer etc	Nos	7	7
G.7.4	Temperature Gauges	Nos	14	14
G.7.5	Pressure Transmitters / Absolute Pressure Transmitters/Differential Pressure Transmitter	Nos	60	60
G.7.6	Pressure Gauges	Nos	15	15
G.7.7	Positon Transmitters for Extraction NRV Position	Nos	10	10
G.7.8	Speed Sensors	Nos	6	6
G.8.0	PRESSURE INSTRUMENTS RACKS			
G.8.1	Instrument rack TYPE A 2150mm(W) x 700mm(D) x 2150mm(H)	Set	6	6
G.8.2	Instrument rack TYPE B 1250mm(W) x 700mm(D) x 880mm(H)	Set	4	4
G.9.0	IMPULSE PIPES - TURBINE			
G.9.1	SEAMLESS C.S.TUBE 21.3X2.3 ST-BQ-A1-CDS-TUBE	Mtrs	200	200
G.9.2	CARBON STEEL TUBE 88.9x4 ST-B-HFSPIPES (RACK OF COND.INST.)	Mtrs	80	80
G.9.3	SEAMLESS C.S. TUBE 21.3X2.3 ST-BQ-A1-CDS-TUBE (RACK OF EXT & GLAND SEAL INS)	Mtrs	150	150
G.9.4	SEAMLESS C.S.TUBE 21.3x2.3 ST-BQ-A1-CDS-TUBE (RACK OF WATER INJECTION INST.)	Mtrs	120	120
G.9.5	SEAMLESS A.S. TUBE D=13.5X2.6 ST-2.25 CR-1MO-TUBE (TEMP. & PR. CONNECTION)	Mtrs	20	20
G.9.6	S.L TUBES (GR.T22)21.3X2.77 ST-2.25 CR-1MO-TUBE (RACK OF EXT & GLAND SEAL INS)	Mtrs	60	60
G.9.7	GR:T91 (13.5X2.6) HTS -ALY- ST-TUBE (TEMP. &PR. CONNECTION)	Mtrs	10	10
G.9.8	SEAMLESS TUBE GR.T91 21.3x7.47 HTS -ALY-ST-TUBE (RACK OF MS PR.INSTRUMENTS)	Mtrs	350	350
G.9.9	SEAMLESS A.S. TUBE 21.3X2.77 HTS -ALY- ST-TUBE (RACK OF HRH/MS PR.INSTRUMENTS)	Mtrs	200	200
G.10.0	JUNCTION BOXES-TO BE INSTALLED AND COMMISSIONED			
G.10.1	Junction Box (to be mounted as per hardwar drg)	Nos	16	16
G.10.2	JB for thermocouple HPT, IPT, LPT1&2, TSE, IPC exhaust, LPC outer etc	Nos	12	12
G.10.3	Push button for TG and lube oil room	Nos	12	12
G.10.4	STRUCTURAL STEEL (for both turbine and generator instruments) 50x50x6 angle	MT	1	1
G.11.0	INSTRUMENTS FOR HEAT EXCHANGERS (CONDENSER, GSC, LP HEATER-1, TOC, CFC)- TO BE COMMISSIONED			
G.11.1	Level Switches (Float type)	Nos	7	7
G.11.2	Temperature Gauges	Nos	16	16
G.11.3	Pressure Gauges	Nos	4	4

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
G.11.4	MIS type Thermometer	Nos	16	16
G.11.5	Thermowell (125/175/325)	Nos	40	40
G.12.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
G.12.1	Condenser Vacuum Pump Removal, calibration and commissioning of CVP skid mounted instruments including CVP PLC and motor mounted on the skid. The approximate quantity of skid mounted instruments shall be Pressure Transmitters - 02 Nos., Pressure Indicators – 04 Nos., Temperature Transmitters - 03 Nos., Temperature Indicators - 04 Nos., Flow Indicator cum Switch – 01 No., Level Indicator-1 No., Rotameter-01 No., Level Switches – 02 Nos., DP Switch – 1 , Diff. Pr.Indicator-01 No., Junction Box-1 No. & Temperature Element-02 Nos., Pneumatic Butterfly Valve-01 No.,	Set	2	2
G.12.2	LT drives for Vacuum pump, Recirculation pump,	Nos	4	4
G.12.3	Oil Centrifuge Unit - Removal, calibration and refixing of all instruments mounted on centrifugal unit, checking and commissioning of the system.	Set	2	2
G.12.4	NRV Valves, Stop Valves, Control Valves, HP/LP Bypass Valves with accessories	Set	40	40
G.12.5	Position Transmitters (Removal, calibration and re-fixing)	Nos	19	19
G.12.6	Limit Switch (checking only)	Nos	76	76
G.12.7	Solenoid Valves (checking only) (steam turbine ext.valves & condenser)	Nos	61	61
G.12.8	Motorized temperature control valve with accessories for cold gas	Set	1	1
G.12.9	Motorized temperature control valve with accessoirers for primary water	Set	1	1
G.12.10	Governing System Control rack : Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below: Pressure Gauges : 9 Nos. Pressure Switches : 4 Nos.	Set	2	2
G.12.11	Main Oil Tank: Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below: Pressure Gauges : 9 Nos. Pressure Switches : 4 Nos	Set	1	1

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
G.12.12	LP Bypass Control Rack/Skid: Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below Transmitters(Pressure, Temp &Level)-7 Nos. Switches(Pressure, DP& Flow)-6 Nos. Pressure gauges:5 Nos	Set	1	1
G.12.13	Seal Oil Rack consists of differential pressure regulating valves, equalising valves & flow regulators including Pressure Indicators- 13 Nos., DP Indicators-02 Nos., DP Switch-2 Nos., Pressure Switch- 01 Nos. & Flow Indicators-06 Nos. and Temperature indicators/Elements- 14 Nos.	Set	1	1
G.12.14	Stator Water Rack consists of Conductivity meter-3 Nos., Level indicator cum switch-01 No., Flow meters-04 Nos, Flow Transmitters-02 Nos., Pressure gauges-03 Nos, Pressure Transmitters-04 Nos, DP Transmitters- 01 Nos., DP Switches-03 Nos.,Temperature Elements-04 Nos., Temperature Indicators-03 Nos. & Sight Glass-03 Nos.	Set	1	1
G.12.15	Seal Oil Level / PrTxr Instrument Rack consists of Level Switches- 04 Nos., Level Indicators- 01 Nos., Pressure Transmitters-12 Nos.	Set	1	1
G.12.16	Stator Water DP Instrument Rack consists of Pressure Transmitters - 04 Nos., DP Transmitter-01 Nos., DP Switches-03 Nos.,, Pressure Gauges-03 Nos.	Set	1	1
G.12.17	H2 Dryer Unit consists of Temperature Gauge, DP Indicator, DP Transmitter, Pressure Gauge	Set	1	1
G.12.18	MOV Actuators	Nos	30	30
G.13.0	LAYING AND TERMINATION OF INSTRUMENTATION CABLES			
G.13.1	Overall Shielded Cable			
G.13.1.1	2P x 0.5 sqmm	Mtrs	15000	15000
G.13.1.2	4P x 0.5 sqmm	Mtrs	10500	10500
G.13.1.3	8P x 0.5 sqmm	Mtrs	3500	3500
G.13.1.4	12P x 0.5 sqmm	Mtrs	1500	1500
G.13.1.5	2P x 0.5 sqmm (Cu braided)	Mtrs	6500	6500
G.13.1.6	4P x 0.5 sqmm (Fire Survival)	Mtrs	3500	3500
G.13.2	Individual & Overall Shielded Cable			
G.13.2.1	4P x 0.5 sqmm	Mtrs	7000	7000
G.13.2.2	8P x 0.5 sqmm	Mtrs	13000	13000
H	BHEL-BHOPAL SCOPE OF SUPPLY			
H.1.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
H.1.1	PT 100 Simplex/Duplex - 3 Wire/4 Wire RTD Sensors for winding/bearings of MDBFP/Drip Pump/CEP/CWP/Mill/DMCW/ACW,etc Motors	Nos	789	717
H.1.2	Motor Temperature Indicators (Removed, Calibrated & Re-fixing)	Nos	46	46
H.1.3	Electric Actuators for various sizes of Valves	Nos	51	39
H.1.4	11 kV HT Drives ID/FD/PA/MDBFP - Each 2 Nos., CW Pump- 5 Nos	Nos	7	7
H.1.5	3.3 kV HT Drives DMCW(TG)/CEP/ACW - 3 Nos each., Mills-8 Nos, BCW-1 No., Drip Motor 2 Nos.	Nos	22	22
H.1.6	3.3 kV HT Drives of other applications (Stage wise)	Nos	16	0
I	VOID			
J	BHEL-PEM SCOPE OF SUPPLY			
J.1.0	Instruments			
J.1.1	Ultrasonic Flow Transmitter with Controller (Raw Water/Ash Water/CW & ACW)	Nos	14	0
J.2.0	Laying and Termination of I/O Shielded, Screened, Twisted Pair, Type F Armoured Instrumentation Cables			
J.2.1	4 Pair x 0.5 sqmm	Mtrs	66000	66000
J.2.2	8 Pair x 0.5 sqmm	Mtrs	45000	45000
J.2.3	12 Pair x 0.5 sqmm	Mtrs	9600	9600
J.2.4	20 Pair x 0.5 sqmm	Mtrs	9600	9600
J.3.0	Laying and Termination of Overall Shielded, Screened, Twisted Pair, Type G Armoured Instrumentation Cables			
J.3.1	2 Pair x 0.5 sqmm	Mtrs	56200	56200
J.3.2	4 Pair x 0.5 sqmm	Mtrs	45200	45200
J.3.3	8 Pair x 0.5 sqmm	Mtrs	114400	114400
J.3.4	12 Pair x 0.5 sqmm	Mtrs	23000	23000
J.4.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
J.4.1	Control Valves with Smart Positioner, AFR, Air Lock Valve etc., LO TCV, Gland Steam inlet and dump	Set	29	29
J.4.2	Electric Actuators for Butterfly Valves	Nos	2	2
J.4.3	Oxygen Dosing Skid for CPU/Dearator O/L - Approximate qty of instruments per skid is Pressure Gauges: 03 Nos., Mass flow controllers- 02 Nos., Pressure Safety Valve - 2 nos. Pressure Transmitter: 6 Nos., Solenoid Valves : 5 No. Junction boxes: 2 Nos, oxygen cylinders - 8 Nos + 11 loose cylinders	Set	2	2

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
J.4.4	Ammonia Dosing Skid - Approximate qty of instruments per skid is Pressure Gauges: 08 Nos., Level Gauge- 04 Nos, Pressure Transmitter: 04 Nos, level Transmitter: 06 Nos Differential Pressure indicating Transmitter - 02 Nos & Solenoid Operated Gate Valves - 06 Nos.	Set	1	1
J.4.5	NaOH Dosing Skid - Approximate qty of instruments per skid is., Pressure Gauges-03 Nos., Level Gauge-01 Nos, Level Transmitters: 02 Nos. Pressure transmitter-02 Nos. & Solenoid Operated Gate Valves - 02 Nos.	Set	1	1
J.4.6	Hydrazine dosing system Approximate qty of instruments per skid is Pressure Gauges: 08 Nos., Level Gauge- 04 Nos, Pressure Transmitter: 04 Nos, level Transmitter: 06 Nos Differential Pressure Transmitter-02 Nos. & Solenoid Operated Gate Valves - 06 Nos.	Set	1	1
J.5.0	Citric Acid Cleaning for Boiler - Installation and Removal			
J.5.1	Temp. Gauges	Nos	2	2
J.5.2	Pressuer Gauges	Nos	2	2
J.5.3	Thermocouple Stem type and MTM	Nos	8	8
J.5.4	Junction Boxes	Nos	3	3
K	BHEL-PESD SCOPE OF SUPPLY FOR FIRE FIGHTING AND FIRE PROTECTION SYSTEMS			
K.1	Instruments of Medium Velocity Water Spray System (MVWSS)			
K.1.1	Pressure Switches	Nos	194	194
K.1.2	Pressure Gauges	Nos	106	106
K.1.3	Solenoid Valves	Nos	106	106
K.1.4	Erection and Commissioning of Deluge Valve Control Panels of App. Dimension 400(L)x150(D)x400(H) and App. Wt 25 kg.	Nos	106	106
K.1.5	Laying and Termination of 2Cx1.5 sqmm armoured copper control cable	Mtrs	1470	1470
K.1.6	Q.B Detector - 79 °	Nos	4645	4645
K.2	C&I of High Velocity Water Spray System (HVWSS)			
K.2.1	Pressure Switches	Nos	40	40
K.2.2	Pressure Gauges	Nos	20	20
K.2.3	Solenoid Valves	Nos	20	20
K.2.4	Erection and Commissioning of Deluge Valve Control Panels of App. Dimension 400(L)x150(D)x400(H) and App. Wt 25 kg.	Nos	20	20
K.2.5	Laying and Termination of 2Cx1.5 sqmm armoured copper control cable	Mtrs	310	310
K.2.6	Q.B Detector - 79 °	Nos	864	864

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
K.3	Fire Detection & Alarm System (FDA)-Erection and Commissioning of items as detailed below.			
K.3.1	Fire Alarm Panels (with Optical Fibre Card and Batteries) of App. Size: 1000(H)x600(W)x300(D) in mm and App. Wt 100 kg each.	Set	4	4
K.3.2	Repeater Panels of App. Size: 1000(H)x600(W)x300(D) in mm and App. Wt 100 kg each.	Set	3	2
K.3.3	Multisensor Detectors	Nos	1020	1020
K.3.4	Air Sampling Detectors	Nos	3	3
K.3.5	Laying and fixing of PVC Pipes for Air Sampling Detectors (No separate payment for this item. Rate may be included in Air Sampling Detectors)	Mtrs	600	600
K.3.6	Probe Detectors	Nos	3	3
K.3.7	Beam Detectors	Nos	5	5
K.3.8	Infra Red Ember Detectors with Air Purge Unit	Nos	46	46
K.3.9	Infra Red Flame Detector	Nos	5	5
K.3.10	Manual Call Points (Indoor, Outdoor, Flamproof)	Nos	170	170
K.3.11	Optical LHS Cable of OD app. 3.8 mm. (Please refer the details for handling and erection)	Mtrs	30000	30000
K.3.12	Optical LHS Controllers of size 100 (W) x 450 (D) x 370 (H) and app. Wt. 10 kg each.	Nos	3	3
K.3.13	Modules of size 130 (W) x 60 (D) x 95 (H) and app. Wt. 0.1 kg each.	Nos	460	460
K.3.14	Hooter cum Strobe	Nos	100	100
K.3.15	Power Supply Modules (230 V to 24 V DC Converters) of size 400 (W) x 250 (D) x 120 (H) and app. Wt. 15 kg each.	Nos	30	30
K.3.16	Response Indicators	Nos	240	240
K.3.17	Exit Sign (Backlit)	Nos	100	100
K.3.18	Laying and Termination of Loop Cables 3Cx2.5 Sqmm	Mtrs	51000	51000
K.3.19	Laying and Termination of Power Cables 3Cx2.5 Sqmm	Mtrs	24000	24000
K.3.20	Laying and Termination of Optical Fibre Cable	Mtrs	9000	9000
K.3.21	Splicing of OFC	Nos	40	40
K.3.22	Cable Tray - 200 mm (Perforated Type)	Mtrs	100	100
K.3.23	Cable Tray - 100 mm (Perforated Type)	Mtrs	400	400
K.3.24	Cable Tray - 50 mm (Perforated Type)	Mtrs	1200	1200
K.4	PLC AND HMI-Erection and Commissioning of items as detailed below.			
K.4.1	Armoured FO cable (Connection between FPS PLC and FDA Panel)	Mtrs	800	800
K.4.2	2" Rodent proof HDPE conduits	Mtrs	800	800
K.4.3	Splicing of OFC	Nos	5	5
K.4.4	Armoured FO cable (Connection between PLC,OWS & RIO Panel)	Mtrs	3520	3520

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
K.4.5	2" Rodent proof HDPE conduits	Mtrs	3520	3520
K.4.6	Splicing of OFC	Nos	5	5
K.4.7	Laptop- Receiving from stores, configuring the system with required software as per OEM recommendation in Fire Detection & Alarm System	Nos	1	0
K.4.8	Configuration of Graphic Software with 2 Licences as per OEM recommendation in Fire Detection & Alarm System	Set	4	0
K.4.9	Establishment of OPC Connectivity (for Main fire alarm panel) in Fire Detection & Alarm System	Set	1	0
K.4.10	Establishment of MODBUS/Network connectivity among FDA panels in Fire Detection & Alarm System	Set	1	0
K.4.11	Video Wall of size 4200 (W)x1600(H) having resolution 2688x1080 pixels with LED/LCD based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand / arrangement etc. in Unit Control room app. Wt. 100 kg.	Set	2	0
K.5	Inert Gas Extinguishing System (IGES)-Erection and Commissioning of items as detailed below.			
K.5.1	Contact Pressure Gauge Unit with inbuilt Pressure Switch	Nos	46	46
K.5.2	Release Device MX1230/200 Electrical (24V DC Operated)	Nos	5	5
K.5.3	Release Device MX1230/200 Pneumatic Operated	Nos	41	41
K.5.4	Disable Device MX	Nos	1	0
K.5.5	Limit Switch Disable Device	Nos	1	0
K.5.6	Pneumatic Release Device PAE - CO2 Electrical	Nos	1	1
K.5.7	Limit Switch Pneumatic operated	Nos	6	6
K.5.8	Abort Switch	Nos	6	6
K.5.9	Manual Release Switch	Nos	6	6
K.5.10	Discharge Indicator 135 (L) x 130 (W) x 40 (D); App. Wt. 5 kg each.	Nos	6	6
K.5.11	Pre-Discharge Indicator 135 (L) x 130 (W) x 40 (D); App. Wt. 5 kg each.	Nos	6	6
K.5.12	Gas Release Panels of size 2040 (W) x 1460 (H) x 400 (D) with Ni-Cd Batteries; App. Wt. 150 kg each.	Set	1	0
K.5.13	Laying and termination of Control Cables of 2C x 1.5 Sqmm armoured Control Cable	Mtrs	2240	2240
K.5.14	300 mm Cable Tray & Accessories	Mtrs	30	30
K.6	Erection and/or commissioning of the following Battery system for various Diesel Engine Driven pumps			

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SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
K.6.1	Batteries of Diesel Engine driven Hydrant Pumps- 6 cells per battery (12 V each)-180 AH, Size of each battery is app. 521x278x270 (mm) and nominal wt. is 55.1 kg.	Set	2	0
K.6.2	Batteries of Diesel Engine driven Spray Pumps-6 cells per battery (12 V each)-180 AH, Size of each battery is app. 521x278x270 (mm) and nominal wt. is 55.1 kg.	Set	1	0
K.6.3	Batteries of Diesel Engine driven Hydrant Booster Pump 6 cells per battery (12 V each)-180 AH, Size of each battery is app. 521x278x270 (mm) and nominal wt. is 55.1 kg.	Set	1	0
K.6.4	Batteries of Diesel Engine driven Spray Booster Pump 6 cells per battery (12 V each)-180 AH, Size of each battery is app. 521x278x270 (mm) and nominal wt. is 55.1 kg.	Set	1	0
K.6.5	Batteries of Diesel Engine driven foam pump-6 cells per battery (12 V each)-180 AH, Size of each battery is app. 521x278x270 (mm) and nominal wt. is 55.1 kg.	Set	1	0
L	Electronic Earth Pits			
L.1	Treated Earth pit of CI pipe 3000 m long with funnel and accessories including all civil works in hardrock by drilling, 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 fixing of manhole CI cover plate/RCC Slab etc. complete as per IS 3043 (only 100 mm CI pipe shall be supplied by BHEL). If desired resistivity is not achieved then Bentonite mix to be used by the contractor. Supply of Bentonite mix is in the scope of bidder.	Nos	25	25

NOTE:

1. The Price bid contains the consolidated list of BOQ with brief description of items.
2. 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.

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VOLUME-IA PART –I CHAPTER –X GENERAL

- 1.10.1** 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.
- 1.10.1.1 Bidders are requested to furnish the following at PSSR-HQ immediately after release of Letter of Indent (LOI).
- a. Security Deposit and Additional Security Deposit
 - b. Unqualified Acceptance of Detailed LOI/Work Order.
 - c. Rs.100/- Stamp paper for preparation of Contract Agreement
- 1.10.1.2 Bidders are requested to furnish the proof of documents for the following at PSSR-Site.
- a. Provident Fund (PF) Registration Number
 - b. Labour License Number
 - c. Workmen Insurance Policy Number
- 1.10.2 **In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following:**
- 1.10.2.1 BOCW ACT & BOCW WELFARE CESS ACT**
- 1.10.2.1.1 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.
- 1.10.2.1.2 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL.
- 1.10.2.1.3 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.
- 1.10.2.1.4 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.

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1.10.2.1.5 Contractor shall make remittance of the BOCW cess as per the Act **in consultation with BHEL** as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and contribution of Beneficiaries remitted

1.10.2.1.6 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 to the BOCW Act and also discharge of total payment of Cess under the BOCW Cess Act by the Contractor, BHEL shall consider refund of the Amounts

1.10.2.2 PROVIDENT FUND & MINIMUM WAGES

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

1.10.2.2.2 The contractor shall ensure the payments of minimum labour wages to the workmen under them as per the rules applicable from time to time in the state.

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

1.10.2.3 OTHER STATUTORY REQUIREMENTS

1.10.2.3.1 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.

1.10.2.3.2 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.

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- 1.10.2.3.3 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.
- 1.10.2.3.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workman under I D Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act 1948 (If applicable) to BHEL along with the Final Bill.
- 1.10.2.3.5 In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.
- 1.10.2.3.6 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.
- 1.10.2.4 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN**
- The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.
- 1.10.2.4.1 The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training. Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in- Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy

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qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

1.10.3 OTHER GENERAL REQUIREMENTS

- 1.10.3.1 The scope of specification covers the installation, testing and commissioning of the erected equipment / instrument along with accessories as detailed in Bill of Quantity.
- 1.10.3.2 Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erecting the equipment, aligning, fastening, supporting, cleaning, checking and carrying out statutory tests as required, trial operation, pre-commissioning, commissioning and post-commissioning activities up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion contract period (including extended period) whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.
- 1.10.3.3 Scope of work covered under this specification requires quality workmanship, engineering and construction management.
- 1.10.3.4 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.
- 1.10.3.5 It is not the intent to specify herein all details of 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.
- 1.10.3.6 The contractor shall have valid ELECTRICAL LICENCE as required to carry out the scope of work indicated in the BOQ.
- 1.10.3.7 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.
- 1.10.3.8 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.

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- 1.10.3.9 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.
- 1.10.3.10 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.
- 1.10.3.11 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. 1.10.3.13 of TCC and Cl. No. 2.16.1 of GCC.
- 1.10.3.12 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.
- 1.10.3.13 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.
- 1.10.3.14 After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.
- 1.10.3.15 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.
- 1.10.3.16 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.

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- 1.10.3.17 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.
- 1.10.3.18 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.
- 1.10.3.19 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.,
- 1.10.3.20 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.
- 1.10.3.21 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.
- 1.10.3.22 All the surplus, damaged, unused materials, package materials, containers, special transporting frames, gunny bags etc. shall be returned to the BHEL stores / customer's stores by the contractor.
- 1.10.3.23 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.
- 1.10.3.24 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.
- 1.10.3.25 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

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such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

- 1.10.3.26 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.
- 1.10.3.27 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe/tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange themselves all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.
- 1.10.3.28 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.
- 1.10.3.29 No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.10.3.30 Contractors shall ensure that all their Staff/Employees are exposed to periodical training program conducted by qualified agencies/ personnel on ISO 9001 /2015 Standards.
- 1.10.3.31 For other agencies, such as piping, Boiler, ESP, TG, Instrumentation, 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.
- 1.10.3.32 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.
- 1.10.3.33 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.
- 1.10.3.34 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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- 1.10.3.35 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.
- 1.10.3.36 All the equipment /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.
- 1.10.3.37 It is the responsibility of the contractor to do the alignment, checking, etc., if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.
- 1.10.3.38 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.
- 1.10.3.39 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.
- 1.10.3.40 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.
- 1.10.3.41 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.
- 1.10.3.42 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there is no extra cost in this regard.
- 1.10.4 **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.**
- 1.10.5 **SITE INSPECTION**
 - 1.10.5.1 Various Inspection / quality control / quality assurance procedures/methods at various stages of erection and commissioning will be as per BHEL / Customer quality control procedure / codes and other statutory provisions and as per BHEL Engineer's instructions.

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- 1.10.5.2 The owner / employer or their authorized agents may inspect various stages of work during the currency of the contract awarded to them. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.
- 1.10.5.3 BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL.
- 1.10.5.4 Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost 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.
- 1.10.6 MANPOWER REQUIREMENT**
- 1.10.6.1 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 5 years of experience in Thermal Power Station.
 - e. Lab Technicians should have 2 years experience in Thermal Power Stations.
 - f. Contractor should have one Store Keeper, one Transport Supervisor for the safe transportation of materials.

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- g. Planning / safety Engineers should be available and they should have experience in construction field especially in power plant.
 - h. Dedicated commissioning engineer should be deployed for commissioning of the equipment.
- 1.10.6.2 There shall be three separate Erection In-charges, each for Boiler, TG Station C&I. They shall work independently with required manpower, T&P etc., including storage facilities. Each Erection In-charge shall have minimum two erection engineers with adequate Supervisors and Technicians.
- 1.10.6.3 There shall be separate engineers for Planning, Safety and Quality.
- 1.10.6.4 Planning/Safety Engineers should have experience in construction field especially in power plant.
- 1.10.6.5 Each area engineer shall be provided with minimum four (04) supervisors and adequate number of Technicians / electricians and other erection staff and T&P etc. The testing Engineers / supervisors / electricians shall be identified separately for each unit and the minimum requirement shall be as indicated in previous Clause. Besides, there shall be separate engineers for Planning, Safety and Quality.
- 1.10.6.6 The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor.
- 1.10.6.7 The testing Engineers/supervisors/electricians shall be identified separately for each unit as per the site requirement.
- 1.10.6.8 The Site in charge shall be provided with PCs and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities will not be an excuse for extension of completion date.
- 1.10.6.9 All instructions from BHEL / Customer will be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name their authorized representative prior to or immediately on commencement of operations at site.
- 1.10.6.10 The Site In charge shall be present at site during all normal working hours and their contact address after normal working hours shall be made available to BHEL so that if any emergency arises, the presence of the contractor's site Representative at site can be called for.
- 1.10.6.11 The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed suffering delay on this account.

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- 1.10.6.12 The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of their duties the contractor shall remove them from site as directed by Site Engineer.
- 1.10.6.13 The contractor shall ensure that all their supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the contractor's personnel shall be brought to the attention of the contractor's site representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required by the Engineer-in-Charge.
- 1.10.6.13 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.
- 1.10.7 DOCUMENTATION**
- 1.10.7.1 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.
- 1.10.7.2 The following information shall be furnished by the bidder after testing and inspection:
- f. Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by customer's representative also, wherever called for as per field quality plan.
 - g. **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.

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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. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipment plants shall be carried out by the contractor.
- 1.11.1.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., de-watering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form/shuttering work are within the scope this work.
- 1.11.1.3 The contractor at their cost shall arrange for grouting of foundation bolt holes of equipment as specified in the drawings / specification or as advised by the Engineer of BHEL after preparing the foundation top surface for grouting, all the materials for grouting (sand, gravel & cement including special Cement) shall be arranged by the contractor. The grouting has to be done up to basement level. The required consumables like Portland cement, gravel, sand etc., have to be provided by the contractor at their cost. The required special cement like conbextra, GP1, GP2, PAGAL, shrinkomp etc., or its equivalent as approved by BHEL if required shall be arranged by the contractor at their cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.
- 1.11.1.4 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 30 mm for obtaining proper face for packer plates/shims, and may be required for the erection of the equipment/plants will have to be carried out by the contractor without extra cost.
- 1.11.1.5 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipment.
- 1.11.1.6 Foundation pockets are to be cleaned thoroughly before placing the equipment. Verticality of foundation bolts to be checked along with correctness of the

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- threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.
- 1.11.1.7 The concrete foundation, surfaces shall be properly prepared by chipping, as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment. Packer plates should not only be blue matched with foundation but also inter-packer contact surfaces between the packers and foundation frame etc., shall also be blue matched by Prussian Blue match checks and required percentage contact shall be achieved by chipping and scrapping as per BHEL Engineers instructions.
- 1.11.1.8 The certificates of the grout are to be submitted to BHEL. If necessary, test cubes are to be made and tested at site to ensure the quality of the grout as per relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc to be arranged by the contractor including the fine aggregates.
- 1.11.1.9 Certain packer plates and shims over and above the quantity received as part of supplies from manufacturing units of BHEL will have to be cut out from steel plates/sheets at site by the contractor to meet site requirement. However, machining of the packers, wherever necessary, will be arranged by BHEL at free of cost.
- 1.11.1.10 Shims and packer plates required for temporary use are to be arranged by the contractor within the quoted rate.
- 1.11.1.11 The contractor at their cost shall arrange for grouting of anchor points of T & Ps issued to them. Necessary grout materials are to be arranged by the contractor at their cost.
- 1.11.1.12 Works such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin etc. are covered in the scope of work.
- 1.11.1.13 Minor civil works like drilling, chipping and punching holes on slabs and brick-walls and grouting related to installation of LIR / LIE / Local Gauge Board, control panels, Junction boxes etc., shall be included in the erection cost of such items. No separate payment is applicable. The scope also includes supply of grouting material. More details regarding scope of civil are given in the respective equipment erection.
- 1.11.1.14 **PROCEDURE FOR GROUTING:** Contractor has to carry out the grouting as per the work instructions for grouting available at site.

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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 ground and to circulate air under the stored equipment. This will also help in lifting the packing with fork lift truck.

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- 1.12.2.4 Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced when decolonization takes place or regenerated. 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 risk and 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 falls 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 falls 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 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.

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- 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 C&I WORKS-DETAILED

- 1.13. THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:**
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)
It is not the intent to specify herein all details of material. Any item related to this work, not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.13.1 DETAILED SCOPE OF C&I WORK**
- 1.13.1.1** 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, preassembly, 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 equipments, Testing instruments (excepting proprietary type instruments), returning of un-used materials / items to stores are also covered in the scope of work.
- 1.13.2 SCOPE OF WORK FOR C&I PANELS / CONTROL DESK:**
- 1.13.2.1** The different types of Microprocessor based panels like VALMET DCS / PLC Panels, Instrument Panels, unit control desk etc. are covered in the scope of work for erection and commissioning.
- 1.13.2.2** The unit rate quoted for Installation of control panels shall include fixing of anti-vibration pads, levelling and alignment, welding, grouting, drilling of bottom gland plates for cable entry as required, closing control panels bottoms with suitable flame proof compounds wherever required and checking of internal wiring, instruments, components etc. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels except the Instruments identified in the BOQ.
- 1.13.2.3** Panels are normally supplied in suite of one / two / three/ four cubicles with bottom base frame and these panels are to be mounted on separate site fabricated base frames as per site condition. The base frames to be properly grouted to the concrete floor or to be TIG welded to the embedded insert plates. The structural steel material for the above will be supplied by BHEL. For fabrication and erection of frame, unit rate shall be paid be as quoted in rate schedule, on tonnage basis.
- 1.13.2.4** For panels to be mounted on trenches, if any channel supports are required, the same shall be provided across the cable trenches over which the base frames of the panels shall be mounted. Similarly for the panels to be mounted

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- on false flooring, if mounting frames are not provided, same shall be fabricated at site. The contractor shall carry out fabrication and erection of these support structures on tonnage rate basis. For fabrication and erection of frame, unit rate shall be paid as quoted in rate schedule, on tonnage basis.
- 1.13.2.5 The panels which are supplied for various control systems have to be erected at different places like unit control room/ near the equipment/ various operating floors as per site layout. The contractor shall take the panels to the desired locations either through floor openings or temporary openings. No claims will be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.
- 1.13.2.6 If any minor grinding is to be carried out on the cut-outs provided in the panels for mounting instruments like recorders, indicators, console etc., the same shall be carried out by the contractor at no extra cost.
- 1.13.2.7 All the panels and JB's shall be electrically earthed to the nearest earth grid by means of GI wire/Flats as per the instructions of BHEL engineer.
- 1.13.2.8 Painting of fabricated parts and earthing conductors of panels shall be part of the work. Touch up painting for panels, including supply of paints shall be carried out by the contractor within the quoted rate.
- 1.13.2.9 Closing the Panel openings and unused drilled holes with non-flammable sealant materials, including supply of above material, shall be part of erection work.
- 1.13.2.10 For panels/ equipment erected by other agencies, commissioning work and troubleshooting are to be carried out by the contractor as per the rate quoted in the schedule.
- 1.13.2.11 Normally the panels shall be supplied with instruments / modules mounted and wired. No separate payment shall be made for commissioning of any instrument/ cards/ components. If dismantling of the above such instruments and rewiring is needed at site, the same shall be carried out at no extra cost. If any instruments/ cards/ components supplied as loose items for safe transit, the same shall be mounted and wired at no extra cost unless specified otherwise in the BOQ. Similarly, if any loose supplied instruments /modules are to be mounted and wired on customer panels or any other panels not erected by contractor, the same shall be carried out at no extra cost unless otherwise specified in the BOQ. However, if any major installation/modification/wiring are involved, the same may be carried out as extra work. The decision of BHEL Engineer shall be final in respect of above extra works.
- 1.13.2.12 Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within $\pm 20\%$ 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 considered for payment.

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- 1.13.2.13 **UPS, AC & DC DB AND OTHER ELECTRICAL CONTROL PANELS:**
The erection & commissioning scope of above panels will be in line with clauses above in 1.13.2.0
- 1.13.3 **SCOPE OF WORK OF DCS PACKAGE / HMI/STATION LAN/PADO SYSTEM / SCADA etc WITH RELATED INSTRUMENTATION:**
- 1.13.3.1 BHEL will supply sophisticated VALMET-DNA DCS system. The tentative details of are furnished in the BOQ.
- 1.13.3.2 The scope of DCS system includes erection of sophisticated microprocessor based systems, Valmet DNA control panels, I/O panels, Ethernet switching panels, Network Enclosure cabinets, CPU, Engineers workstations, operator workstations, CRTs, server, printers, portable UPS power supply, furniture and interconnecting cables like Ethernet/Fibreoptic etc.
- 1.13.3.3 The scope of work for DCS Panels will generally be in line with that for C&I Panels as detailed in Clause 1.13.2.0
- 1.13.3.4 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.
- 1.13.3.5 Laying and termination of all cables including Ethernet and fibre 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.
- 1.13.3.6 If any underground C&I works for firefighting systems the earth excavation and earth filling is in the scope of civil.
- 1.13.3.7 **SCOPE OF WORK OF PLC FOR FIRE PROTECTION/FIRE FIGHTING SYSTEMS:**
- 1.13.3.7.1 BHEL will supply PLC Panels and accessories required for FPS/FFS . The tentative details of are furnished in the BOQ. The scope of works for PLC related systems are inline with Cl.No. 1.13.3.1 to 1.13.3.6.
- 1.13.4 **SCOPE OF WORKS FOR UPS, BATTERY AND BATTERY CHARGER:**
GENERAL
- 1.13.4.1 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.
- 1.13.4.2 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.
- 1.13.4.3 Lump sum price 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.
- 1.13.4.4 Collecting the batteries and all the accessories like cable connectors, inter cell connectors, equalizing connectors, rack insulators, fuse box, loop cables etc.

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- from stores and assembling on the racks and fixing all loose supplied items as per drawings.
- 1.13.4.5 Filling the individual cells with Acid/alkali – as applicable.
- 1.13.4.6 Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.
- 1.13.4.7 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.
- 1.13.4.8 Modifications or changes if any for the loose supplied items or any minor changes in wiring.
- 1.13.4.9 Arranging necessary tools, T&P, Testing equipment required for erection and commissioning of the battery.
- 1.13.4.10 For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.
- 1.13.4.11 **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 under CI.No. 1.13.2.0 above.
- 1.13.5 SCOPE OF WORK FOR INSTRUMENTS:**
- 1.13.5.1 The type of instruments to be erected and commissioned shall be detailed below:
- a. Panel mounted Instruments like indicators, recorder, electronic modules etc.
 - b. All types of transmitters like temperature, pressure, flow, level and position feedback transmitters etc.
 - c. 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.
 - d. Air filter regulator sets, Air lock off valve, Power cylinders etc.
 - e. Panel/ Control desk mounted Instruments like indicators, recorder, console and electronic modules etc.
 - f. I/P converters and local controllers.
 - g. 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.
 - h. Pneumatic operated control valves, trip valves, solenoid valves, and electrically operated valves. (commissioning only).
- 1.13.5.2 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.
- 1.13.5.3 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

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- 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.
- 1.13.5.4 Unit rates have been asked item-wise for instruments, gauges, switches, indicators, recorders etc. as indicated in BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items of work of the rate schedule.
- 1.13.5.5 Unit rate quoted 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.
- 1.13.5.6 Unit rate quoted 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.
- 1.13.5.7 Unit rate quoted 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.
- 1.13.5.8 Unit rate quoted 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.
- 1.13.5.9 Unit rate quoted for erection and checking of thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.
- 1.13.5.10 Unit rate quoted for erection and checking of temperature switches, gauges, thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.
- 1.13.5.11 If any instrument is to be relocated for reasons not attributable to the contractor, but required for satisfactory performance, the same shall be carried out on extra works basis.
- 1.13.5.12 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

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- 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.
- 1.13.5.13 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.
- 1.13.5.14 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 equipment.
- 1.13.5.15 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.
- 1.13.5.16 Some of the Flue Gas Analysers are to be installed at Chimney 65 Mtrs and above as indicated in the erection drawings. 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 Mtrs of Chimney to zero meter level, payment will be made at twice the unit rate quoted against each item.
- 1.13.5.17 For Coal Bunker level monitor supply, fixing / erection of the sensors onto legs of Bunkers is in the scope of contractor. However, the contractor shall provide necessary approach platforms with ladders and any other assistance for erection of these sensors.
- 1.13.5.18 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.
- 1.13.5.19 Temporary protection by thermocol, polythene sheet, GI sheets shall be provided by the contractor for safe guarding the instruments against damages. The protective materials shall be supplied by the contractor at no extra cost.
- 1.13.5.20 In case the Instruments are mounted and supplied along with main equipment and the BOQ calls for Erection & Commissioning, the contractor shall carry

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- 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.
- 1.13.5.21 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.
- 1.13.5.22 The scope of work for panels for TSS System, Sonic Tube Leak Detection System, Furnace Flame Viewing System, Master Clock System, Siemens core turbine panel etc. will be in line with the scope of work of C&I panels covered under clause above in 1.13.2.0
- 1.13.6 SCOPE OF WORK FOR IMPULSE PIPES:**
- 1.13.6.1 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.
- 1.13.6.2 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
- 1.13.6.3 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.
- 1.13.6.4 For longer route lengths of impulse pipes, the contractor shall provide Tag numbers at appropriate locations as directed by BHEL site engineer.
- 1.13.6.5 Hydraulic test shall be conducted for all impulse pipes after completion of erection as per site engineer's directive, as part of the work.
- 1.13.6.6 The contractor shall obtain necessary approval for welding electrodes, filler wire from BHEL welding engineer at site.
- 1.13.6.7 Impulse pipes Welder shall undergo test and get approval from BHEL welding engineer according to the nature of welding.

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- 1.13.7 SCOPE OF WORK FOR PRE-FABRICATED/ SEMI-FABRICATED LIR/ LIE/ GAUGE BOARDS CABLES TERMINATION**
- 1.13.7.1 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.
- 1.13.7.2 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.
- 1.13.7.3 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.
- 1.13.7.4 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.
- 1.13.8 SCOPE OF WORK FOR COPPER/STAINLESS STEEL TUBES:**
- 1.13.8.1 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 6meter. The connectors and tees will be of brass / Stainless Steel of different sizes as per site requirement.
- 1.13.8.2 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 air line instruments. The unit rate shall also include providing tag plates on instruments / power cylinders.
- 1.13.8.3 If copper / Stainless Steel tube length is more than half meter, suitable support shall be provided either by angle or trays. Protective angles to be used for copper tube routing. The support materials shall be supplied by BHEL. For fabrication and installation of steel supports and frames, the rate shall be as quoted in BOQ for fabrication and installation of steel Tonnage basis.
- 1.13.8.4 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.
- 1.13.9 SCOPE OF WORK FOR INSTRUMENT AIR LINES (GI PIPES):**
- 1.13.9.1 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.

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- 1.13.9.2 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.
- 1.13.9.3 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.
- 1.13.9.4 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.
- 1.13.10 SCOPE OF WORK OF ELECTRIC & PNEUMATIC ACTUATORS:**
- 1.13.10.1 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.
- 1.13.10.2 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 air line, 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.
- 1.13.10.3 The link rods have to be adjusted to suit the opening and closing position. This adjustment has to be repeated number of times till proper operation is obtained. If BHEL site engineer desires to remove the accessories like position transmitters, air locks, positioners, limit switches, solenoids etc. prior to erection either at BHEL stores or at site to avoid damages/pilferage, keep in safe custody and remount the same prior to commissioning, this shall be part of scope of work for power cylinders.
- 1.13.10.4 For calibration of any Pneumatic Actuator at field, temporary air supply if required shall be arranged by the contractor.
- 1.13.10.5 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.
- 1.13.10.6 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

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of the same. Payment shall be made in line with rate quoted for Erection and Commissioning of power cylinder of similar type.

- 1.13.10.7 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.

1.13.11 SCOPE OF WORK FOR CABLES:

- 1.13.11.1 BHEL will supply LT, 1.1 kV, armoured/ unarmoured, Copper PVC FRLS 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.
- 1.13.11.2 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.
- 1.13.11.3 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.
- 1.13.11.4 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.
- 1.13.11.5 Unit rates quoted for cabling shall also include supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 2.5 sq.mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed elsewhere in this tender.
- 1.13.11.6 Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, underground, cable shafts etc.
- 1.13.11.7 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.
- 1.13.11.8 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.

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- 1.13.11.9 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.
- 1.13.11.10 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.
- 1.13.11.11 Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.
- 1.13.11.12 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 their supervisor or technicians to assist the commissioning agencies to check the interconnecting cables at no extra cost.
- 1.13.11.13 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.
- 1.13.11.14 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.
- 1.13.11.15 Any fabrication required at site for cable support shall be carried out at the rate quoted for fabrication.
- 1.13.11.16 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services any such adjustment shall be done with the approval of Engineer.
- 1.13.11.17 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.
- 1.13.12 SCOPE OF CABLE TERMINATION:**
- 1.13.12.1 Laying and termination of all cables including Ethernet, fibre optic cable is part of the scope.
- 1.13.12.2 The scope of termination shall include termination of cables on various panels / JB's / Push buttons / equipment etc. including those installed by other agencies.
- 1.13.12.3 Re-termination, if required during testing/ commissioning shall be carried out without additional cost.

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- 1.13.12.4 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.
- 1.13.12.5 Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.
- 1.13.12.6 Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.
- 1.13.12.7 After cable terminations, the debris shall be removed then & there. Also refer Cl.No. 1.13.11.0 above.
- 1.13.13 SCOPE OF WORK FOR CABLE TRAYS/CONDUITS/FLEXIBLE CONDUITS/HOSE:**
- 1.13.13.1 **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:
- 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.
 - 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.
 - 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.
 - 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.
 - Site fabrication / modification of trays or on tray accessories will be paid on extra work basis.
 - The contractor shall quote a uniform rate on meter basis for erection of trays and Tray accessories like Tees, Reducers, Bends, cross etc.
 - 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.
 - 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.
- 1.13.13.2 **RIGID & FLEXIBLE CONDUITS:**
- Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe/flexible conduits

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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.

1.13.13.3 **SCOPE OF WORK FOR JUNCTION BOXES/JBs /PUSH BUTTON BOXES:**

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

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

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

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

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

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

1.13.14 **SCOPE OF WORK FOR FABRICATION & ERECTION OF STEEL MATERIALS:**

1.13.14.1 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.

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- 1.13.14.2 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.
- 1.13.14.3 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.
- 1.13.14.4 All fabricated steel materials shall be painted as detailed in the scope of painting.
- 1.13.14.5 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.

1.13.15 SCOPE OF EARTHING:

- 1.13.15.1 The scope of earthing covered in this contract is above ground earthing i.e equipment earthing. Scope of earthing covers earthing of field Instruments, JB's, 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.
- 1.13.15.2 Different type of earthing materials shall be supplied and same shall be erected as per site requirement.
- 1.13.15.3 The scope of work shall include supply of fasteners, lugs, minor civil works etc.
- 1.13.15.4 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.
- 1.13.15.5 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.

1.13.16 SCOPE OF CALIBRATION:

- 1.13.16.1 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.
- 1.13.16.2 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.
- 1.13.16.3 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 their verification and approval.
- 1.13.16.4 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

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- contractor shall provide all supports like manpower ,standard T&P, Instruments etc., for calibration and testing of above proprietary instruments.
- 1.13.16.5 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.
- 1.13.17 MEASUREMENTS, WASTAGE & CUTTING ALLOWANCES:**
- 1.13.17.1 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.
- 1.13.17.2 The measurement for cable, impulse pipes/tubes, GI pipe, conduits, flexible conduits, trays etc. shall be made on the basis of length actually laid.
- 1.13.17.3 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.
- 1.13.17.4 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.
- 1.13.17.5 While carrying out material reconciliation with contractor, all the above points will be taken into account. All serviceable material returned by the contractor shall be deducted from the quantities issued for the respective sizes and categories and the balance quantity(ies) will be taken as the net quantity(ies) issued to the contractor. Material appropriation shall be done and allowable scrap quantity calculated as per wastage allowance specified below. Any scrap / wastage generated by the contractor in excess of the allowable percentage shall be charged at the rates decided by the Engineer whose decision shall be final and binding on the contractor.
- 1.13.17.6 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.
- 1.13.17.7 Every month the contractor shall submit an account for all the materials issued to them by BHEL in the standard proforma prescribed for this purpose by the site in charge.
- 1.13.17.8 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

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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 their own cost.

- 1.13.17.9 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
01	Fabrication Steel	2
02	Each size of power cables	1
03	Each size of control / instrumentation cables	2
04	Impulse pipe / tubes / GI Pipes / Copper Tubes	1

NOTE:

1. Salvageable scrap shall mean lengths of pipes, multicables, 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.
2. 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.

- 1.13.17.10 **VIBRATION MONITORING SYSTEM (VMS):**
Following E&C works are covered under Contractor scope under the supervision of OEM.

- i) Erection of Junction box & Driver housing.
- ii) Erection of VMS Panel in Control Room. Power supply extension to VMS Panels.
- iii) Erection of cable from JB to VMS Panel; including both end cable termination.
- iv) Erection of cable from VMS Panel to DCS Panel; including both end cable termination.

Following are excluded from the scope of contractor:

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1. Checking and calibration of sensors
2. Mounting of sensors (Vibration/phase/proximity,etc)
3. Sensor Cabling up to JB
4. Healthiness checking and complete commissioning of the system.
5. Loop Checking between panel to DCS
6. Handover of the system to End user

1.13.18.10 **TURBINE SUPERVISORY CONTROL SYSTEM (TSS):**

For Main Turbine:

Collection of materials from stores, Preparation of mounting surface and mounting arrangement to suit the surface of the machine, Installation of JBs- 12 Nos., Laying & Terminations of Instrumentation cable from Lcal JB and Cabinet, Laying and termination of Power cable to TSS panel, Laying and termination of ethernet cables (as applicable), Laying and Termination of FO cables. (Mounting sensors on the Machines, Laying and termination of cables between sensors to Local JB, Pre-commissioning check, energizing cabinets & PC (as applicable), Commissioning, Installation of software packages, handing over to the enduser are in the scope of OEM).

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VOLUME-IA PART – I CHAPTER – XIV

PROGRESS OF WORK

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

1.14. PROGRESS OF WORK

- 1.14.1 Refer forms F -14 to F-18 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 program.
- 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 their work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.
- 1.14.7 The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out on each weld and maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any,

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- percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required.
- 1.14.8 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes / ferrules / lugs) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL formats.
- 1.14.9 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- 1.14.10 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
- 1.14.11 The monthly report shall be submitted at the end of every month as a booklet and shall contain the following details: -
- a. Colour photographs of the works progress.
 - b. Erection progress in terms of tonnage, percentage of work completion, welding joints, radiography, stress relieving, etc., completed as relevant to the respective work areas against planned.
 - c. Site Organization chart of engineers & supervisors as on the last day of the month with further mobilization plan
 - d. Category- wise man hours engaged during the previous month under the categories of fitters, welders, riggers, khalasis, grinder-men, gas-cutters, electricians, crane operations, store keepers, lab technicians, helpers, security etc. Data shall be split up under the work areas like Boiler (pressure parts, structures) Rotating machines, Electro static precipitator, Insulation, Piping, Steam turbine, Condenser, Generator etc.
 - e. Consumables report giving consumption of all types of gases and electrodes during the previous month.
 - f. Availability report of cranes & T&Ps
 - g. Safety implementation report in the format
 - h. Pending material and any other inputs required from BHEL for activities planned during the subsequent month.
- 1.14.12 The contractor to reflect actual progress achieved during the month and shall 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:

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

1.15.2 SCOPE OF PRE-COMMISSIONING / COMMISSIONING AND POST COMMISSIONING WORKS:

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. 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.

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

1.15.2.2 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,

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

- 1.15.2.3 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.
- 1.15.2.4 After erection of various equipment 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.
- 1.15.2.5 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.
- 1.15.2.6 In case 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 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 have 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.
- 1.15.2.8 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.
- 1.15.2.9 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

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and testing & commissioning activities shall be carried out in accordance with the checklist.

- 1.15.2.10 The scope of commissioning shall also cover the commissioning of the equipment / drives erected by the mechanical contractors. (as detailed in the BOQ)
- 1.15.2.11 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.
- 1.15.2.12 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 Contractors Scope
- 1.15.2.13 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.
- 1.15.2.14 Commissioning Engineers also shall be identified separately for each unit and the minimum requirement shall be as indicated below (Requirement given below is per unit).

	Boiler	TG	Station C&I	BOP and Misc	TOTAL
Engineer (C&I)	01 No.	01 No.	01 No.	01 No.	04 Nos.
Supervisor (C&I)	03 No.	03 No.	03 No.	03 No.	12 Nos.
Technician (C&I/Electrical)	08 No.	06 No.	08 No.	08 No.	30 Nos.

- 1.15.2.15 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.
- 1.15.2.16 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.
- 1.15.2.17 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.

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- 1.15.2.18 T & P / instruments required for testing are to be arranged by the contractor.
- 1.15.2.19 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.
- 1.15.2.20 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.
- 1.15.2.21 **Scope of commissioning of equipment erected by the mechanical contractor:**
- a. 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.
 - b. The scope of work also includes collecting the replacement instruments / parts from BHEL / customer stores, stockyard etc.
 - c. Separate group shall be identified for commissioning. The above group shall be available right from Trial run to full load operation including shift operation.
- 1.15.2.22 **PNEUMATIC (ALL TYPES OF VALVES AND POWER CYLINDERS)**
- a) Calibration and checking of instruments mounted on the actuators and setting stroke length of the actuator.
 - b) Servicing of positioners, position transmitters, limit switches, solenoid valves, air lock-off valves, removing/replacement of defective components, copper tubes etc., if necessary.
 - c) If the actuator is to be removed for attending to any mechanical problems, removing of copper tubes, cables etc. reconnecting and re-commissioning of the actuators is to be done.
 - d) Testing and checking the remote / local operation in Auto as well as Manual mode.
 - e) Fixing of instruments if supplied as loose items.
 - f) Attending to any defects till the contract period.
- 1.15.2.23 **FLOW METERS / SWITCHES**
- a) Checking the calibration and servicing if required.
 - b) Setting the alarm value
 - c) Replacement of defective components if any
- 1.15.2.24 **LIMIT SWITCHES & LEVEL SWITCHES**
- a) Checking the operation
 - b) Replacing defective components if required

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1.15.2.25 **SOLENOID VALVES**

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

1.15.2.26 **TEMPERATURE ELEMENTS (MOTORS AND GENERATORS WINDING AND BEARING)**

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

1.15.2.27 **DIRECT WATER LEVEL GAUGES (REMOTE & LOCAL)**

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

1.15.2.28 **INSTRUMENTS MOUNTED ON THE EQUIPMENTS / SKIDS / PANELS**

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

1.15.2.29 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.

1.15.2.30 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 them.

1.15.2.31 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 their cost.

1.15.2.32 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.

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- 1.15.2.33 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.
- 1.15.2.34 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 their 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.
- 1.15.2.35 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.
- 1.15.2.36 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.
- 1.15.2.37 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.
- 1.15.2.38 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.
- 1.15.2.39 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

1.16. PAINTING

1.16.1 FINAL PAINTING

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

- 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. which forms the part of this tender book.
- 1.16.1.2 The scope of painting generally includes painting of all steel items such as supports, racks, frames, canopy, LIE/LIR/LGB, impulse pipes, etc. carried out by the contractor. Painting shall be carried out for any bare copper tubes also.
- 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 surface 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 Spray painting has to be carried out within the Quoted wherever required/asked for. Spray painting gun and compressed air arrangement has to be made by the contractor themselves.
- 1.16.1.9 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.
- 1.16.1.10 Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted. Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.,

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- 1.16.1.11 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.
- 1.16.1.12 All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.
- 1.16.1.13 Finish coat paint, No of coat and DFT shall be as indicated in the painting specification enclosed in this tender / relevant BHEL document/ customer's specifications. The painting specification which is forming part of this tender as in TCC shall be used as guidelines to be followed.
- 1.16.1.14 The actual colour to be applied shall be approved by the customer before starting of actual painting work.
- 1.16.1.15 Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the BHEL / Customer approved agencies only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities.
- 1.16.1.16 No paint shall be applied when the surface temp is above 55 deg. Centigrade or below 10 deg. Centigrade, and when the humidity is greater than 90% to cause condensation on the surface or frost / foggy weather.
- 1.16.1.17 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.
- 1.16.2 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

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- paint matching with shop paint / approved final colour. Besides above two coats of approved primer paint is to be applied on all the bare / unpainted surfaces. Touch up painting is generally required for trays, control panels.
- 1.16.2.3 All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.
- 1.16.2.4 Contractor shall carryout cleaning and preservation / touch up painting for the materials / 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.

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VOLUME-IA PART- II

CHAPTERS 1-7

Chapter 1 to 7 in next pages are as below

Chapter	DESCRIPTION	No. of Pages
Chapter -1	Corrections / Revisions in General Conditions of Contract and Forms & Procedures	01
Chapter -2	Data Sheet	02
Chapter -3	Technical Requirements and Guidelines for Installation, Testing, Commissioning and Supply items of C&I package	21
Chapter -4	T&P Hire Charges	12
Chapter -5	HSE Plan for Site operations by Subcontractors (Document No. HSEP: 14 Rev02)	131
Chapter -6	Drawings & Schemes c. HMI Configuration drawings d. Write up on Lab Instruments	49
Chapter-7	No Deviation Certificate (Rev. 01)	1

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VOLUME-IA PART – II CHAPTER 1 CORRECTIONS / REVISIONS IN GENERAL CONDITIONS OF CONTRACT AND FORMS & PROCEDURES

Sl. No.: 1

The chapter Reverse auction procedure published in 'Forms and Procedures' of Volume I Book-II stands deleted. (**Explanation:** Reverse auction is not applicable for this Tender).

Sl No.: 2

Existing format on No Deviation Certificate, as available in Form No F-03 of Volume ID Forms and procedure stands Deleted.

Revised Format is enclosed at Chapter 7 below in Volume IA Part II.

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VOLUME-IA PART – II CHAPTER 2 DATA SHEET

2.3.1 SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

2.3.1.1 CLAMPS:

- A. Material type:** Nylon Self-Locking ties Aluminium strips clamps as mentioned in Chapter-3 of Technical Conditions of Contract (Volume-IA Part-II in Book-I)
- B. Sizes:** To meet the requirements mentioned in Chapter-3 of Technical Conditions of Contract (Volume-IA Part-II in Book-I)

2.3.1.2 FERRULES: As mentioned in Chapter-III of Technical Conditions of Contract (Volume-IA Part-I in Book-I)

2.3.1.3 TAGS:

- A. Material:** Aluminium / Fibre / Stainless Steel
- B. Markings:** Engraving / Embossing / Printing
- C. Size:** As required

2.3.1.4 CABLE LUGS: Copper / Aluminium (Crimping Type)

2.3.1.5 CLAMP SPACING:

A. Power Cables:

Above 35 mm OD

- i) Horizontal Runs: Individually clamped at 3000 mm Interval (max)
- ii) Vertical Runs: Individually clamped 3000mm intervals (max)

Up to 35 mm OD

- i) Horizontal Runs: Collectively clamped at 3000 mm intervals (max)
- ii) Vertical Runs: Collectively clamped at 2000 mm interval (max)

B. Control Cables:

- i) Horizontal Runs: Collectively clamped at 3000 mm interval (max)
- ii) Vertical Runs: Collectively clamped at 3000 mm interval (max)

C. Spacing for Cables supported along structure / ceiling

- i) Horizontal Runs: 750 mm (max)
- ii) Vertical Runs: 750 mm (max)
- iii) Spacing between cables: 30 mm (min)
- Note:

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- a. Supports shall also be proved at each bend.
- b. For any change in above spacing, prior approval of Engineer shall be taken.

CABLE TERMINATION:

Type of Lugs

- a. **Power Cables:** Copper / Aluminium / Both crimping type
- b. **Control Cables:** Copper pin type, copper screw type, Direct termination
- c. **Special Cables:** Pin type, maxi-termi type

Wastage Allowance:

2.3.1.1

<u>Material</u>	<u>Allowance permitted</u>
Structural Steel:	2% (by weight)
Cable Tray:	2%
LT Cable:	1%
Control, Instrumentation & Special Cable:	2%
Fire Survival Cables:	1 %
Impulse Pipe/Tubes/GI Pipes/ Copper Tube:	1%
Earth flats:	2%

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VOLUME-IA PART – II CHAPTER 3 GENERAL TECHNICAL REQUIREMENTS AND GUIDELINES FOR INSTALLATION, TESTING, COMMISSIONING AND SUPPLY ITEMS OF C&I PACKAGES

2.3.1 GUIDELINES FOR INSTALLATION OF C&I EQUIPMENT

- 2.3.1.1 Instruments location shall be decided to the convenience of operation and maintenance. The location shall have least mechanical vibration and placed where corrosive, toxic and explosive gases and dust particles will not deposit and the place is not subject to high-temperature atmosphere or radiation. However, actual location shall be decided in consultation with customer / consultant.
- 2.3.1.2 Maintenance platforms & approach facilities shall be provided for all sensing & primary devices wherever possible. Instruments shall be located in weatherproof enclosures and wherever required suitable canopy shall be provided.
- 2.3.1.3 High & Low pressure impulse lines shall not be grouped and run together. Also impulse lines for explosive & inert gases shall not run together.
- 2.3.1.4 Impulse lines of high pressure steam, harmful gases, etc. shall not be brought into the control room, as far as possible.
- 2.3.1.5 Intrinsically safe circuits shall be used for explosion hazardous areas.
- 2.3.1.6 Separate cable routing shall be followed for high and low voltage lines.
- 2.3.1.7 All electrical equipments shall meet the requirements of Indian Electricity Rules.
- 2.3.1.8 Wherever severe vibrations are expected, shock absorbers shall be provided.
- 2.3.1.9 Installation of instruments with radioactive isotopes, mercury and other toxic substances shall be as per statutory regulations provided by authorities.
- 2.3.1.10 Compensating cables should be connected directly to instruments, i.e. no junction boxes shall be used if CJCBs are not provided.
- 2.3.1.11 Orifice plates or flow nozzles must be provided with at least 10D upstream and 5D downstream straight length of pipe from bends tees, branch pipes & control valves.
- 2.3.1.12 Pressure gauges shall be provided with snubbers, syphons (for more than 100°C), three way valve manifolds wherever applicable.
- 2.3.1.13 For pneumatic instruments, air shall be dry & free from oil. Air must be supplied from oil-free compressors specially erected for this purpose. After drying, air must be restored in receiver. Pressure gauges must be provided on each supply line and after the pressure reducer.
- 2.3.1.14 Correct level (height) between detecting element and tapping point and transmitter shall be maintained.

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- 2.3.1.15 The equipment shall maintain its normal posture (level, perpendicular, front and back).
- 2.3.1.16 Connection between detecting element/tapping point and transmitter shall be maintained at short distances wherever practicable to avoid any time lag.
- 2.3.1.17 Orifice plates and control valves shall be mounted on process piping, only after completion of cleaning of the process piping in order that these instruments may not suffer damage from metal waste, etc.
- 2.3.1.18 For details of installing each measuring instruments, instruction manual issued by the respective manufacturer of instruments may be referred to, wherever necessary.
- 2.3.1.19 The drain pipes shall be terminated in a common closed header and finally the common header shall be connected to plant open drain.
- 2.3.1.20 Impulse pipe material shall be identified for each individual pipe prior to its use at site. For this purpose coloring is to be done immediately after receipt.
- 2.3.2 GUIDELINES FOR ERECTION OF IMPULSE LINES**
- 2.3.2.1 All impulse lines burrs and airlines shall be thoroughly cleaned of any foreign matter by cleaning with compressed air and the same shall be done before installation.
- 2.3.2.2 The routing of pipelines shall include sufficient flexibility near tappings to allow for thermal expansion of the process equipment.
- 2.3.2.3 The pipes shall be cold bent using hydraulic bending machines only.
- 2.3.2.4 The horizontal impulse lines shall be laid with proper slopes towards the tapping point.
- 2.3.2.5 Supports for piping and tubing shall be adequate and in no case exceed limits shown below:
a) ¼" OD / ⅜" OD Copper - Continuous
b) ½" NB Pipe / Tube - 5'
c) ¾" NB Pipe / Tube - 5'
d) 1" NB Pipe / Tube - 8'
- 2.3.2.6 All impulse line welding shall be done through welding generator/rectifier and only structural welding could be done through welding transformer.
- 2.3.2.7 Impulse pipe of Alloy Steel / Stainless Steel / Carbon Steel shall be TIG welded wher-ever required. Welding of impulse pipe shall be carried out in accordance with BHEL welding procedure. The welding electrodes shall be approved by BHEL welding Engineers. Impulse pipes welders shall undergo welding Test and approved by BHEL welding engineer at site.
- 2.3.2.8 Minimum number of fittings shall be used on all lines wherever possible, to keep threaded joints to a minimum wherever thread connections are to be made.
- 2.3.2.9 The impulse pipe laying is recommended to be limited to a maximum of 10 metres (each limb) generally, unless otherwise specified, to have optimum response from the transmitter. However, this will depend upon plant layout.

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- 2.3.2.10 Where the tapping point is subjected to mechanical shift due to heating / cooling of main equipment, care should be taken to route the impulse pipe in such a way as to absorb the shift of tapping point without straining the impulse piping. To accommodate this, sufficient loop for the impulse pipes can be provided near to the tapping point.
- 2.3.2.11 Alternatively hose assembly - S.S. flexible may be used for connection between tapping point and impulse pipe.
- 2.3.2.12 The expansion bends are to be avoided as far as possible, as these act as air/sedimentation traps hampering the system performance.
- 2.3.2.13 Impulse piping shall be arranged as short as possible with a minimum of bends.
- 2.3.2.14 Horizontal piping shall be avoided and 1/10 slope shall be maintained.
- 2.3.2.15 Pipes shall not be laid parallel to high temperature process piping.
- 2.3.2.16 Pipe joints shall be carried out using sockets and flanges. Union fittings may be used when pressure is low. In the case of D.P. instruments both piping on low side and high side shall be maintained at same length and in the same route.
- 2.3.3 IMPULSE PIPING FOR AIR & FLUE GAS SYSTEM**
- 2.3.3.1 For furnace pressure and furnace flue gas, suitable piping for air and furnace flue gas pressure, the impulse pipe shall be arranged to rise vertically from the tapping point to a distance at least of 300 mm before a change of direction is made.
- 2.3.3.2 Arrangements should be made for air purge in the impulse piping system at the end of the instrument airline or roding facilities may also be provided with suitable tees and cross.
- 2.3.3.3 In order to take care of the boiler expansion, suitable flexible connecting pipes can be arranged either at the tapping point end or at the instrument end.
- 2.3.4 IMPULSE PIPING FOR VACUUM MEASUREMENT:**
- The measuring instruments used on vacuum measurement should always be installed above the level of the tapping point in order to minimise measuring errors as much as possible. A suitable condensing chamber can be arranged which will eliminate the condensate or any blocking in the impulse pipe.
- 2.3.5 IMPULSE PIPING FOR STEAM AND WATER SYSTEM**
- 2.3.5.1 As a rule, instrument installation position for steam and water shall be downward from root valves.
- 2.3.5.2 Impulse pipes shall have a minimum slope of 1:10 and shall be supported at every 2 metres length.
- 2.3.5.3 At the transmitter end, the connection can be either through 2 way valve manifold or nipple with coupling.
- 2.3.5.4 In case 2 way manifold used and connected with nipple and coupling, it is necessary to provide tee with plug for purging or venting. The impulse pipe connection to the transmitter from the main pipe may be either upper side or lower side of the transmitter. In any case sufficient slope shall be maintained.

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- 2.3.5.5 Some supplier recommends capillary type tube for transmitter connection from the impulse pipe to instrument by using S.S. tube and compression fittings.
- 2.3.5.6 It is always preferable to mount the instrument below the tapping points because the condensate shall protect the instruments against high temperature. In any case, the temperature entering the instrument should not exceed 150 F. In case the instrument is installed above tapping, before opening the process root valves, the impulse pipe shall be filled with water.
- 2.3.5.7 In the case of high temperature steam applications, sufficient length or siphon shall be provided to ensure certain length of condensate is formed thereby protecting breaking the measuring instruments from high temperature. Snubbers can also be provided if there is likely to be any pulsating of the medium measured.
- 2.3.6 BENDING**
- 2.3.6.1 It is recommended for cold bend for the impulse pipes with the help of a hydraulic bending machine to achieve a particular shape.
- 2.3.6.2 Use of 45° elbow and 90° bends (ready-made) is restricted to bare minimum to minimise the number of joints in a system. Hot bending is not to be used as this leads to flattening of pipes at the bends and also results in thinning of walls, apart from introducing changes in metallurgical properties of the pipe material.
- 2.3.6.3 Hot bending may be permitted for carbon steel pipe for low pressure service as instructed by supervisor only when it cannot be avoided. In the case of 90° bending radius shall be more than 3 times the outside diameter of pipe and in the case of 'u' bending, radius of bending shall be 5 times the outside diameter of pipe. When the radius of bending becomes small, elbow fitting shall be used.
- 2.3.6.4 Large bending shall be so made as to form smooth curve.
- 2.3.7 CUTTING**
- Pipe cutter or wheel grinder shall be used for pipe cutting.
 - Gas cutting shall be avoided.
 - Burr inside the cut end shall be removed.
 - The cutting surface shall be as perpendicular to the axis as possible.
- 2.3.8 Impulse Pipe Welding:**
- a. Generally, welding of impulse pipe and fitting shall be carried out by arc welding and socket welding is adopted. Welding shall be performed by a qualified welder. Only D.C. arc welding is recommended for impulse pipe. Motor generator is preferred to rectifier transformer, since it may damage the welding joints due to surge.
- b. In order to prevent the cracking of the weld it is recommended to provide a small gap between the bottom of the socket and pipe end.
- 2.3.9 Testing:**

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a. 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.

b. 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.

2.3.10 Guidelines for Installation of Pneumatic Line

2.3.10.1 Copper tubing shall be connected with Olive type of compression fittings.

2.3.10.2 When two or more lines run together, the joint in the adjacent alternate line shall be a offset.

2.3.10.3 In case of copper tubing, the single run copper tube may be supported with an angle. However, suitable trays shall be used for more than one tubing.

2.3.10.4 Multi-core copper tubing shall not to be bend less than 10 deg and D is the OD if the multi-core copper.

2.3.10.5 All air distribution, main and branch lines shall be galvanised internally as well as externally and the galvanized pipe, never, shall be braced or welded.

2.3.10.6 The joints shall be screwed with Teflon tapping wherever the pipes are to be removed frequently for cleaning and other purposes and suitable union fittings shall be used.

2.3.10.7 Care shall be taken while taking a branch pipe to see that the line is not taken from the lower part of the main line or main header in order to avoid entry of any drain or dust into the system.

2.3.10.8 Instrument airline should not be routed where severe vibration, high temperature exists and adequate space should be available for maintenance.

2.3.10.9 Care shall be taken when removing the PVC sheeting, while connecting the copper tube. The exposed portion after jointing shall not be excessive and also while removing PVC, the tube should not get damaged. Pipe cutters should not be used for cutting the copper tube, instead the specific copper tube cutter shall be used. Similarly, for bending copper tubes, specific copper tube bender should be used and the radius of the bending shall be more than 2.5 times of the OD of the copper tube.

2.3.10.10 While using the pipe cutter, care shall be taken to remove burr from the cutting side.

2.3.10.11 In locations where the copper tube is likely to be damaged from outside, the copper tube can be routed near a different pipe. While laying copper tube either inside angle or trays, the tube shall be supported at least at every one metre distance.

2.3.10.12 While fixing the copper tube fittings only Teflon tapes should be used. However, no tape shall be used while tightening the ferrules.

2.3.11 Instrument Air line Testing

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a. 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.

b. All pneumatic signal lines shall be disconnected and blown through with instrument air. The line shall be blanked off and pressurized pneumatically 20 psi, and checked with soap solution for leak.

2.3.12 General Guidelines on Installation of Flexible Hoses

2.3.12.1 Flexible hoses can be classified into two broad categories, viz., Rubber hoses and Metallic hoses. The selection of the hoses is made depending upon the service conditions (pressure, temperature and other environmental conditions).

2.3.12.2 Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shrinkage or expansion. (However, excessive slack in hose lines is one of the most common causes of poor appearance).

2.3.12.3 At bends, provide enough hose for a wide radius curve. Too tight a bend pinches the hose and restricts the flow. The line could even kink and close entirely. In many cases, use of the right fittings or adapters can eliminate bends or kinks.

2.3.12.4 In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible and proper installation protects metal parts from undue stress, and avoids kinks in the hose.

2.3.12.5 Hose assemblies in service should be inspected frequently for leakage, kinking, corrosion, abrasion or any other signs of wear or damage. Hose assemblies that are worn or damaged should be removed from service and replaced immediately.

2.3.12.6 The service life expectation of a flexible hose mainly depend on the correct installation layout. In most cases, when flexible hoses fail prematurely, the reason of failure may be found in an incorrect layout.

2.3.12.7 As a rule, the hose is not to be bent over its limit of elasticity. The choice of the right hose length is of crucial importance. The hose should not be subject to torsion. Torsion can be usually eliminated by changing the layout.

2.3.13 General Notes on Installation of Local Instrument Racks and JB Frames

2.3.13.1 In cases where the local instrument stands are to be installed on a concrete foundation, it shall be fixed by anchor bolts.

2.3.13.2 In cases where the local instrument stands are to be installed on the base plate, the stand can be placed on an angle and the same can be welded. However, in cases where there is a probability for removal of stand is likely to arise, it shall be fixed by bolts.

2.3.13.3 Installation of local junction boxes shall be installed in such a way that they are fixed on a column by welding or by fixing bolts.

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- 2.3.13.4 Local Instrumentation rack, which shall be installed utilising the Beam and Structure, shall be fixed by welding. Care shall be taken while deciding the location in order to ensure that no hindrance is caused to the maintenance personnel in their moving space within the work area. Further, as a standard practice, it should be ensured that no instrument stands/racks/JBs shall be supported by/welded on to any of the working equipment, or even hand gridded or floor gridded, as per safety norms.
- 2.3.13.5 Proper care should be taken to ensure that welding of the stand on any structure or Beam is fully welded.
- 2.3.14 General Guideline on Flow Instruments Installation**
- 2.3.14.1 Extreme care shall be taken when welding and assembling the flow element on the pipe. Any misalignment or rough particle or edge inside the welded area may cause inaccuracy and this will increase as the flow increases.
- 2.3.14.2 Flow elements should always be located in upstream from any valve. Downstream side of valve shall no longer be a homogenous mixture and this may cause erratic behaviour of reading periodically.
- 2.3.14.3 Care shall be taken while welding the impulse pipe. Improper arrangement of piping of DP instruments can create error in the reading and even it gives an indication of negative flow of steam even though the flow is to be positive. Inadequate exchange of steam and condensate in the piping may cause negative flow. The presence of burr or dirt in the pipe can impede the flow of condensate back to the pipe, and when this happens, the pipe becomes full of water and has the effect of creating negative head.
- 2.3.14.4 Always $\frac{3}{4}$ " to 1" pipe is recommended for free flow condensate. Gate valve shall be used for the tapping and pipe should be insulated up to condensing pot.
- 2.3.14.5 The Measuring instrument shall be located close to the flow-sensing element. The speed of response is reduced if there is a long run.
- 2.3.14.6 The orifice plates shall be installed such that the extreme face is perpendicular to the axis of the pipe within the +2 deg or -2deg. and it should be ensured that when the extreme face is facing the direction of flow, invariably the sign of positive (+) is marked on the upstream.
- 2.3.14.7 Location of Flow element should have clear straight run of 10D in upstream and 5D in downstream.
- 2.3.14.8 For non-viscous liquid flow measurements, the best location for the instruments shall be below the pipeline, If the instrument is above the line, more maintenance will be involved. Suitable vapour traps shall be provided.
- 2.3.14.9 In the case of air and gas flow measurement system, as part of basic requirement, it should be transmitted to the instruments without any change in the differential head due to leakage.
- 2.3.14.10 If the flow of any dry gases are to be measured, the location of instrument can be kept above or below the tapping points.

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- 2.3.14.11 For air flow measurements, it is always preferable to install the instruments above the pipeline. In case, if the instrument must be installed below the duct/pipeline, suitable Dust Collection Chamber can be installed.
- 2.3.14.12 The condenser pot should be located nearer to the tapping point and both condenser chamber should be at the level of upper tapping.
- 2.3.14.13 The unequal level will cause significant error due to false heads. If the flow nozzle is installed in vertical pipe, the lower tapping pipe which is bent and taken up to upper tapping in order to align with the upper condensate pot, must be insulated, otherwise, error is created when the bent pipe fills with condensate. The error may add or subtract depending upon the direction of flow.
- 2.3.14.14 For flow measurements, the instruments should always be located below the condenser pot, otherwise, the condensate will be lost from the system and the instrument will reach 'O' during the shutdown and the total system must be vented after the start up of the boiler in order to remove Air and Vapour which might have got entrapped.
- 2.3.14.15 In an installation where the instruments must be located above the tapping points and the condensing chamber should be equally located above the instruments the pipeline up to the condensing pot should be insulated.
- 2.3.14.16 In the case of viscous fluids, flow measurements which are likely to freeze or concealed in the pressure pipe or like such corrosive type fluids, suitable sealing chamber shall be used, the sealing liquid should not mix or react with the medium to be measured.
- 2.3.14.17 The commonly used sealing liquid includes water, light oil, glycerol, ethylene glycol and mixtures of the last two with water.
- 2.3.14.18 The sealing chambers, in each pressure pipe, should be installed at the same level and as close as possible to the pressure tapplings.
- 2.3.14.19 The general arrangement for pressure tapplings from the Sealing Chamber to the instrument is shown in the sketch.
- 2.3.14.20 The flow elements should be inspected before installation to find out the presence of any corrosion/rusting or any blockage on the pressure tapping holes or any deposits on the face of the orifice plate.
- 2.3.15 General Guideline on Installation of Valves**
- 2.3.15.1 Primary isolating valves (root valves) must be located at the tapping which can be of globe valves.
- 2.3.15.2 These valves shall be installed where access is possible.
- 2.3.15.3 Secondary isolating valves shall be located at the end of inter-connecting pipe. It should be as nearer as possible to the measuring instruments and should be of needle type.
- 2.3.15.4 For pressure more than exceeding 40 kg, 2 isolating valves shall be provided.
- 2.3.15.5 In the case of heavy duty isolating valves, suitable support shall be provided to avoid any loading on the stubs.

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- 2.3.15.6 In viscous fluids, suitable steam tracing shall be provided.
- 2.3.15.7 These valves are always located as nearer to the measuring device as possible.
- 2.3.16 Blowdown Valves or Drain Valves**
- a. These valves are fixed at the lowest end of impulse pipe
 - b. In the case of high-pressure line always 2 valves shall be fitted in series. Normally, these valves will be of globe type
 - c. For low-pressure application, single valve is used.
 - d. In case of air and flue gas measurements, either a plug or a suitable gate valve of gunmetal 'on/off' valve shall be provided.
 - e. The drain valve shall be connected to the common drain header which finally is terminated at plate operation drain system.
- 2.3.17 PAINTING:**
- All the supporting steelworks impulse pipe shall have protective painting. The surface shall be free from rust, foreign adhering matters, grease etc. Two coats of rust preventing red-oxide primer and final painting of two coats as per the colour DECIDED by the site engineer. After cleaning the surface is painted with one coat of Red oxide zinc chromate primer conforming to IS 2074 and allowed to dry completely. The primer-coated surface is painted with two coats of final painting of desired colour which shall be selected from IS-5.
- 2.3.18 GUIDELINES FOR CABLE LAYING**
- 2.3.18.1 In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.
- 2.3.18.2 In case of multicore cables of diameter upto 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.
- 2.3.18.3 Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.
- 2.3.18.4 GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
- 2.3.18.5 In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy-duty PVC pipes shall be provided.
- 2.3.18.6 Entry of cables through trenches/tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.
- 2.3.18.7 Cables laid exposed in racks / trays and routed through trenches / tunnels / basements etc. to individual drive / control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment in the panels located, above trenches, tunnels or basement.

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- 2.3.18.8 All cables routed along walls or in equipment rooms shall be protected by means of laying them through GI pipes or by providing sheet metal covers up to a height of 2000mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.
- 2.3.18.9 Tray covers shall not be provided for the cable trays within trenches, tunnels and basements. Non-perforated type sheet steel covers shall be provided for the trays in the areas susceptible to accumulation of coal dust/atmospheric abuses etc.
- 2.3.18.10 Cable trays shall be supported on ISA 50 X 50 X 6mm MS / GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas.
- 2.3.18.11 Wherever direct heat radiation exists, heat isolating barriers (subject to customer's approval), for cabling system shall be adopted.
- 2.3.18.12 For 415V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded / exposed GI conduits or rigid PVC pipes as applicable.
- 2.3.18.13 If required, a few number of cables in exceptional areas may be directly buried into the earth.
- 2.3.18.14 Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth as decided by Engineers.
- 2.3.18.15 At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.
- 2.3.18.16 In corrosive atmosphere, PVC conduits shall be used for cables.
- 2.3.18.17 Single core cables, when pulled individually shall be taken through PVC pipes only.
- 2.3.18.18 Laying and installation of power, control and special cables shall generally conform to IS : 1255
- 2.3.18.19 The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
- 2.3.18.20 In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks / trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.
- 2.3.18.21 Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.
- 2.3.18.22 Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius

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- of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255.
- 2.3.18.23 All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor / wall crossings, every 25m spacing for straight runs or as specified by Engineer for easy identification of cable.
- 2.3.18.24 When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.
- 2.3.18.25 Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.
- 2.3.18.26 Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacings not less than one cable diameter of bigger diameter cable.
- 2.3.18.27 All 1100 V grade multicore power cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanised MS saddles / aluminium strips / nylon cable ties. Cables above 35mm diameter shall be clamped individually.
- 2.3.18.28 Control cables shall be laid touching each other and wherever required may be taken in two layers. All control cables shall be clamped with a common clamp / tie.
- 2.3.18.29 Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:
- a. HT cables shall be laid in the top tier(s)
 - b. LT power cables to be laid in the tray(s) below the HT cable trays.
 - c. LT control cables to be laid in the Tray(s) next below to the LT power cable tray(s)
 - d. Special control cables including screened control cables to be laid in the bottom most tray(s).
- 2.3.18.30 For vertical formations, the trays closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed. However, where there is no clear distinction of bottom / top trays, the order convenient for linking the horizontal and vertical formations shall be followed.
- 2.3.18.31 When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses indicated above, the following rules shall override the criteria. However, prior approval of the Engineer will be required.
- In hierarchical order:
- a. Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.
 - b. LT power cables are mixed up with control cable with clear minimum gap of 150mm between them.

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- 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 200mm between them.
- 2.3.18.32 In case of duplicate feeders to essential loads, the respective cables shall be laid through separate raceways. Alternatively, such cables shall be laid on the opposite sides of a trench/tunnel/basement.
- 2.3.18.33 For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanised.
- 2.3.18.34 For laying cables along concrete walls, ceilings etc. The cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 6mm thickness.
- 2.3.18.35 To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.
- 2.3.18.36 No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits / pipes in trefoil formation only.
- 2.3.18.37 In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.
- 2.3.18.38 Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.
- 2.3.18.39 Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.
- 2.3.19 Support Spacings & Clampings:**
Support spacing and clamping suitably provided and as required.
- 2.3.20 Laying of cables directly buried in ground:**
Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.
- 2.3.21 Codes and Standards:**
Installation of cabling work shall comply with the following Indian Standards (Latest editions):
- | | |
|---------|--|
| IS 1255 | Code of practice for installation and maintenance of power cables upto and including 33 kV rating. |
| IS 732 | Electrical wiring installation (system voltage not exceeding 650 V). |
| IS 5216 | Guide for safety procedures and practices in electrical works. |

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IS 226	Structural steel (Standard quality).
IS 800	Code of practice for use of structural steel.
IS 316	Code of practice for use of metal arc welding for general construction in mild steel.
IS 1363	Hexagonal bolts, nuts and screws
IS 1572	Electroplated coatings of cadmium on iron and steel.
IS 2629	Code of practice for hot dip galvanising for iron and steel.
IS 2633	Method of testing uniformity of coating on zinc coated articles.
IS 15908	Selection, Installation and Maintenance of Control and Indicating equipments for Fire Detection and Alarm System-Code of Practice
IS 2189	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System-Code of Practice

In addition to the standards mentioned above, all works shall conform to the requirements of the following rules and regulations.

- a. Indian Electricity Act and Rules framed thereunder
- b. Fire insurance regulations
- c. Regulations laid down by the Chief Electrical Inspector of State
- d. Regulations laid down by the Factory Inspector of State
- e. Any other regulations laid down by the authorities.

In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.

2.3.22 Guidelines For Erection of Cable Trays, GI Pipes, Supports and Accessories

- 2.3.22.1 Constructional details and supporting arrangement for the cable trays shall be as shown in the drawings which will be handed over to the successful bidder. All cable trays, vertical raceways and supporting steel work shall be installed along the routes as indicated in the drawings and as per the instructions of the Engineer-in-charge. The contractor has to fabricate and install complete tray supporting structures as per the drawing / site requirement.
- 2.3.22.2 Wherever specified or directed by Engineer, the contractor shall install galvanised MS sheets covers over cable trays. The width of the covers shall be same as that of cable trays. Bolting shall be done to fasten covers to the cable trays, elbows, reducers, tees, crosses etc.
- 2.3.22.3 The contractor shall install all angles, channels, beams, hangers, brackets, clamps etc. as may be necessary to suit the actual site conditions to support the cable trays.
- 2.3.22.4 Straight pieces of standard MS angles / channels shall be used for fabrication of supports / racks. All welded joints shall be smooth enough to provide a good appearance and shall not cause injury to working personnel.

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- 2.3.22.5 Cable trays within cable trenches, tunnels and basements shall be of ladder type. Bottom most tray within plant buildings for overhead runs of trays shall be of perforated type. Cable trays in the areas exposed to coal dust shall be installed in vertical formation. Wherever due to layout constraints, it is not possible to install the trays in vertical formation with Engineer's prior permission installing the trays in horizontal formation may be considered.
- 2.3.22.6 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way or maintenance of adjacent equipment.
- 2.3.22.7 For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.
- 2.3.22.8 For equipment and devices having GI conduit entry arrangement other than standard GI conduit adopter, adopters shall be provided as required to enable the GI conduit to be properly terminated, between conduit end and motor T.B.
- 2.3.22.9 GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.
- 2.3.22.10 The entire G.I. conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the Gi pipes entering them.
- 2.3.22.11 Bends of G.I. pipes / conduits shall be made without causing damage to the pipes / conduits.
- 2.3.22.12 Occupancy of conduits shall not be greater than 40%.
- 2.3.22.13 The adopter for coupling rigid GI pipe / conduits and flexible conduit shall be of aluminum or galvanized steel.
- 2.3.22.14 Transportation and storage of cable drums
- 2.3.22.15 Transportation and storage of cable drums shall generally conform to the requirements of IS : 1255
- 2.3.22.16 All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.
- 2.3.22.17 The cable drums shall be transported on wheels to the place of work.
- 2.3.23 GUIDELINES FOR CABLE TERMINATION AND JOINTING**
- 2.3.23.1 Contractor shall carry out cable terminations at various electrical and electronic equipment terminals.
- 2.3.23.2 When the equipment are provided with undrilled gland plates for cable / conduit entry into the equipment, drilling and cutting on the gland plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before drilling holes. Cutting shall not be allowed.
- 2.3.23.3 Termination of cables shall be done as per termination drawings & interconnection diagrams furnished to the contractor. Looping of cores / wires at terminals as shown in interconnection diagrams is to be done by the column at no extra cost as part of the termination.
- 2.3.23.4 All cable entries in the equipment shall be sealed after glanding the cables.

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- 2.3.23.5 Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core / conductor.
- 2.3.23.6 Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals.
- 2.3.23.7 Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes / nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.
- 2.3.23.8 Screened control cables of 0.5 sq.mm cross-sectional area shall be terminated by means of wire rapping system.
- 2.3.23.9 Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per the control schemes and other related documents supplied.
- 2.3.23.10 End sealing / termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.
- 2.3.23.11 Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs.
- 2.3.23.12 Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.
- 2.3.23.13 Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.
- 2.3.23.14 Junction boxes shall be used, wherever required, for jointing of control cables.
- 2.3.23.15 Termination and jointing shall generally conform to the requirements of IS: 1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.
- 2.3.24 DESIGN REQUIREMENTS OF ITEMS SUPPLIED FOR CABLING INSTALLATION WORK (IF SUPPLY IS COVERED IN BIDDER SCOPE)**
- 2.23.24.1 **STRIP CABLE CLAMPS:**
 - a. Strip Clamps shall be of aluminium alloy or cast steel or M.S. and shall be used to fasten the group of multicore cables on the tray.
 - b. Clamps shall be of simple construction, made of 4 mm thick, 25 mm wide strip to cover the entire width up to 300 wide tray and part of the tray for more than 300 wide trays. Strip shall have two right angle bends for fixing on the rung with two bolts.

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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.

2.23.24.2 **SELF LOCKING CLAMPS:**

- a. Clamps shall be of nylon material / fibre glass.
- b. Clamps shall have self-locking feature when the cord is looped.
- c. Clamps shall be proved with manual lock release.
- d. Clamp cord shall not move in the backward position once it has been locked unless the lock release is applied.
- e. Type test certificates to ascertain the strength of clamps shall be submitted for Purchaser's approval.
- f. Nylon self-locking clamps shall be of BHEL approved make only.

2.23.24.3 **FERRULES:**

- a. Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter.
- b. Ferrules shall be of plastic material.
- c. Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave coloring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600 mm.
- d. Ferrules shall be interlocking type in such a way that the interlocked ferrules take the shape of tube with complete ferrule number appearing in a straight line.

2.23.24.4 **TAGS:**

- a. Cables shall be provided with cable number tags for identification.
- b. Cable tags shall be of durable fiber, aluminum, stainless steel sheets or lead of suitable thickness.
- c. Cable number shall be engraved type in case of aluminum or stainless steel tags, and printed type in case of fiber sheet.
- d. Tags shall be durable quality of size 60mm x 12mm with holes at both ends.
- e. Samples of tags shall be approved by BHEL Engineer before delivery.
- f. Tags shall be provided with non-corrosive wire of sufficient strength for tagging's.

2.23.25 GUIDELINES FOR EARTHING INSTALLATION:

- 2.23.25.1 All equipment shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.
- 2.23.25.2 The earthing conductors shall be mild steel / G.I. strips / wires. All connections from the equipment to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the successful tenderer.
- 2.23.25.3 A continuous earthing conductor shall be installed in all cables trays and securely clamped to each tray section by suitable connectors to form a

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continuous earthing system. When two or more trays supporting power cables run on parallel a continuous earthing conductors shall be provided on one tray only with tap offs to the control cable trays. All valve and damper motor and rapping motors will be earthed to this conductor.

- 2.23.25.4 All joints in the earthing system shall be welded type. Earthing connections to all equipment including motors shall be bolted type.
- 2.23.25.5 Earthing connections shall be free from tinning scale, paint, grease, rust or dirt at the time of making joint.
- 2.23.25.6 Metallic sheaths, screens / shields and armor of all multicore cables shall be bonded and earthed.
- 2.23.25.7 Earthing conductors along with their run on columns, beams, walls etc., shall be supported by suitable cleats at intervals of 750 mm.
- 2.23.25.8 Conduits shall be bonded together and grounded at all switchgear and control centers.
- 2.23.25.9 M.S.Earthing conductors shall be coated with one coat of bituminous paint, wrapped with a layer of bitumen tape and finally coated with bitumen paint. For site welded GI strips / wires required coat of aluminium paint should be given.
- 2.23.25.10 If the equipment is not available at the time of earthing conductor laying tap connections from the main earthing conductor shall be brought out up to slab equipment foundation level with at least 200 mm spare length left for further connections to equipment earthing terminals.

2.23.26 Guidelines for Erection of Control Panels and Distribution Boards

- 2.23.26.1 The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base channels will have to be grouted. Suitable concrete drilling machine shall be used for making hole on the concrete floor.
- 2.23.26.2 For the panels which are to be mounted on the trenches, channel supports have to be provided across the cable trenches over which the base frames of the panels shall be mounted. Fabrication and installation of these support structures shall be carried out as per drawings.
- 2.23.26.3 All the panels / board shall be placed on its foundation or supporting structures and shall be assembled equipment as required. All equipment should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.
- 2.23.26.4 All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.

2.23.27 The following points shall be checked up during erection

- i. Layout of foundation channels.
- ii. Floor level covered by the panel with respect to main floor level.

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- iii. Location and serial no. panels.
- iv. Positioning of panels.
- v. Verticality of panels and breaker truck to station earth.
- vi. Earthing of panels and breaker truck to station earth.
- vii. Lugs for termination of HT and LT cables.
- viii. Mounting and fixing arrangements all modules.
- ix. Check the operation of:
 - a. Remote control
 - b. Various required - closing / tripping / alarm / indications / interlocks
Installation position of instruments and relays
Operation of relays and instruments.
- x. AC / DC supplies for panel.
- xi. Tightness of terminal connections for HT & LT connections.
- xii. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

2.3.28 415 V SWITCHGEAR AND ELECTRICAL PANEL TESTS (AS APPLICABLE)

- a. IR Test on each pole of breaker
- b. IR test on control circuit
- c. Measurement of contact resistance for all three phases of breaker
- d. Measurement of resistance of the closing and tripping coil of breaker
- e. Checking the close trip operation at 70% and 100% of the rated auxiliary D.C. Voltage.
- f. Checking of interlocks provided and tripping of breaker through relays
- g. Space heater operation check
- h. Opening and closing time check
- i. Control and metering circuit checks
- j. Primary and secondary injection tests
- k. Thermal overload relay testing and checking
- l. Calibration of all instruments and meters
- m. Phase rotation checks

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n. High voltage test on 7C.1.3 kV switchboard

2.3.29 CUTTING & WASTAGE ALLOWANCE:

The following scrap allowances are permissible:

Sl.No.	Description	Non-Salvageable	Unaccountable
01	Length below 0.5 m steel pipes Stainless/ Copper tubes, Single Pair Cables	2 %	0.5 %
02	Length below 20 m multi cable, multi tubes.	2 %	0.5 %

2.3.30 GUIDELINES FOR HANDLING OF SOLID STATE MODULES:

- All the solid-state modules shall be handled by qualified person.
- Electronic modules should only be touched when it is absolutely essential.
- Before touching any electronic modules, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strip.
- The operator should not wear clothing made entirely from synthetic fibres, but a mixture containing atleast 65% cotton.
- PCB should always be held by the front panel or by the module frame and the electronic components should never be touched.
- The electronic modules should never be placed close to television sets or CRT units.
- Soldering irons and any other tools used must be grounded.
- All modules using CMOs components are packed in antistatic bags, when transported loose to avoid ESD failures. The antistatic bags must always be used to transport modules at site from one place to the other.

2.3.31 GUIDELINES FOR LANDING AND STORAGE OF ELECTRONIC CUBICLES / SUB-ASSEMBLIES / LOOSE ITEMS.

- 2.3.31.1 Immediately after unloading at site, the electronic equipment should be kept in the covered area. Handling and lifting of the package should be done without jerks or impacts. Packing case should not be dripped or slid along the floor under any circumstances. Suitable forklift should be used to move the case to its final position. All the above points are to be strictly followed as the electronic equipments cannot withstand any stress due to vibration and shock.
- 2.3.31.2 After unloading at site, the package of the equipment shall be inspected for external damage. In case the package is damaged, the package number and

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.

2.3.31.3 Cases should be opened / unpacked using correct nail pullers. While opening the planks, care should be taken to see that the equipment is not damaged. Cases should not be unpacked in areas where they are exposed to rain water / liquid splashing, dust or other harmful materials like chlorine gas, sulphur dioxide etc.

2.3.31.4 After opening the case, all supports provided for transport are to be removed with due care.

2.3.31.5 Hinged frames should not be opened when equipment is not secured to the floor as this is likely to cause it to topple over. The hinged frame can be opened only if the equipment is still fixed on to the bottom wooden pallet.

2.3.32 GUIDELINES FOR INSTALLATION OF LHS/OLHS/LHD/OLHD CABLES UNLESS OTHERWISE SPECIFIED BY OEM (OR) INSTRUCTED BY SITE ENGINEER

2.3.32.1 **STORAGE:** These cables should not be stored in the areas where the temperature is above the rated maximum ambient temperature. Storage nearer to boiler, furnace or any heat producing equipment may activate the cable and lead to shorting of the cable.

2.3.32.2 DOs and DON'Ts WHILE HANDLING:

- Due care must be given while handling these cables as these cables are easily prone for damage and sensitive to heat.
- Test for continuity between the leads. If it is short circuit, cable is not usable.
- Avoid any mechanical stress on the cable by pinching/crushing/bending, etc.
- Avoid installing next to mechanical (or) thermal process that may cause damage.
- Do not over tighten with fasteners.
- Avoid 90° bending of the cable, all bends shall be made by hand with the minimum radius specified by the OEM.
- Do not paint the cable.
- Allow for expansion/contraction due to temperature.
- Install with OEM recommended installation accessories such as mounting clips, spring clips, splice connectors, etc.
- Wherever required use SS messenger wire esp. inside the covered conveyors.
- If messenger wire is used, it shall be properly terminated.
- For Ceiling installation, pipe mount (or) wall mount applications use mounting clip (SS 304) (or) as specified by the OEM.
- Terminate the open ended cables as specified by OEM.
- To connect two cables, use strain relief glands (Splice Connectors).

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- Allow suitable slack (or) sag between any two fastening points.
- While connecting two lead cables, following procedure may be adopted.
 1. Strip outer insulation and inner connections.
 2. Bend inner conductors by hand (no pliers)
 3. Insert & tighten in the splicing connectors
 4. Seal splice using sealant tape.
 5. Tape splice using Electrical tape.

Note: *All the above are minimum guidelines. However, the actual guidelines as recommended by OEM may be followed. BHEL Site Engineer's decision will be final.*

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 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 m³/Hr)	1160
22	Air Blower (Flow: 20000 m³/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	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	430

**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	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL 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**

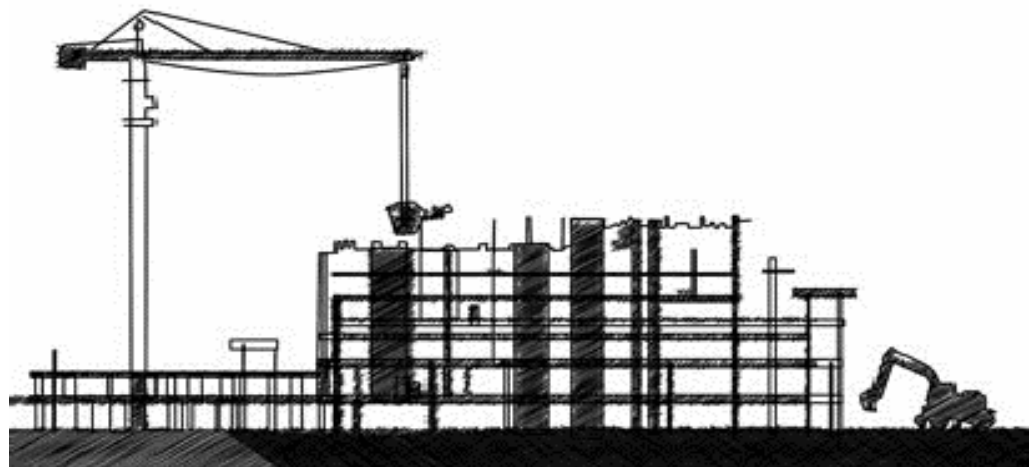
SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	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

**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.

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

Index of **Annexure I** is given as under

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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

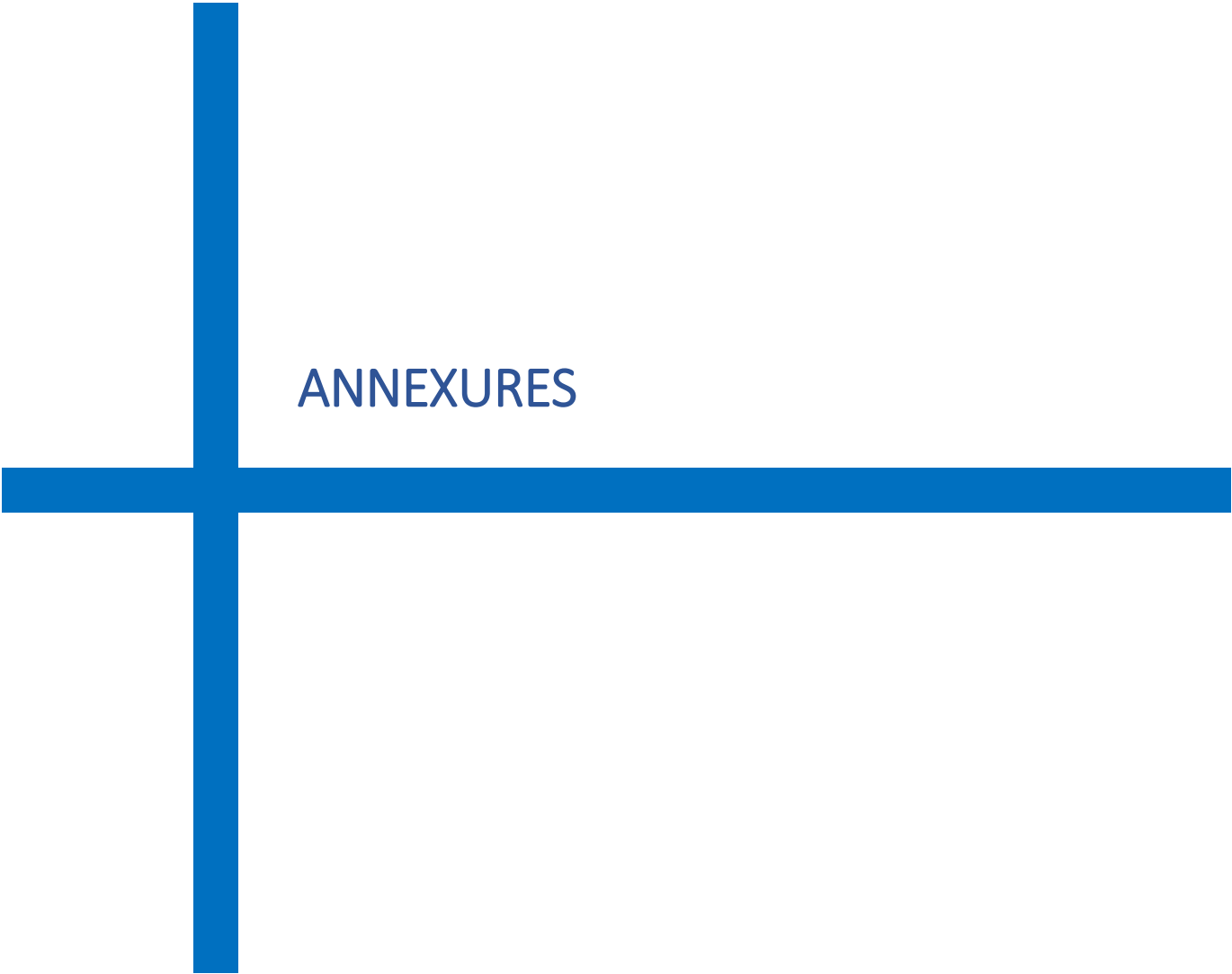
19. Safety Committee:

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.

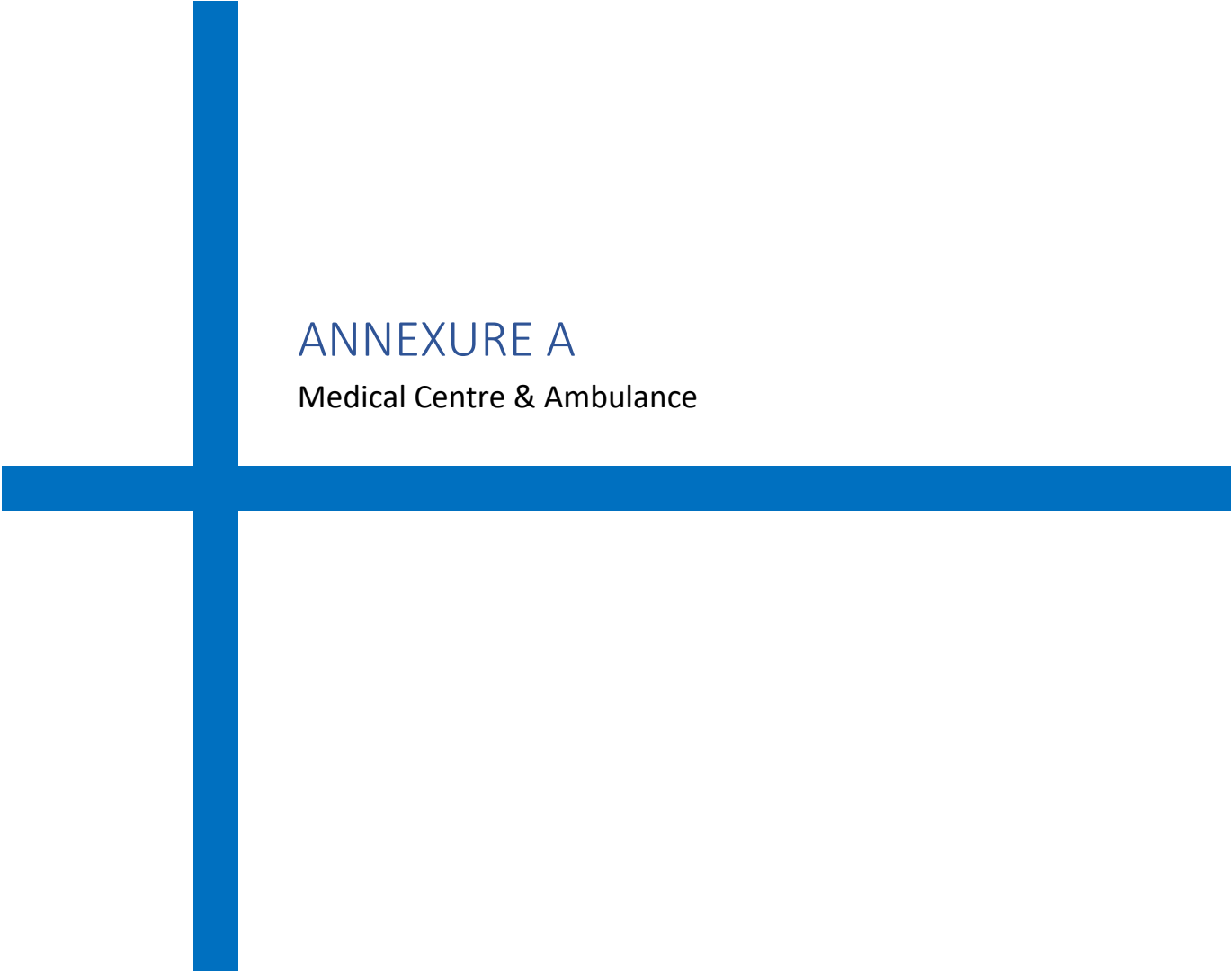
20. Night Work:

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 annemias arematations (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 two 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 toxoid.
- 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.
- xl.ii. One stethoscope and a B. P. apparatus.
- xl.iii. Rubber bandage—pressure bandage.
- xl. iv. Oxygen cylinder with necessary attachments.
- xl. v. Atropine eye ointments.
- xl. vi. I. V. Fluids and sets 10 nos.
- xl. vii. Suitable, foot operated, covered, refuse containers.
- xl. viii. Adequate number of sterilised, paired, latex hand gloves.

B. Ambulance

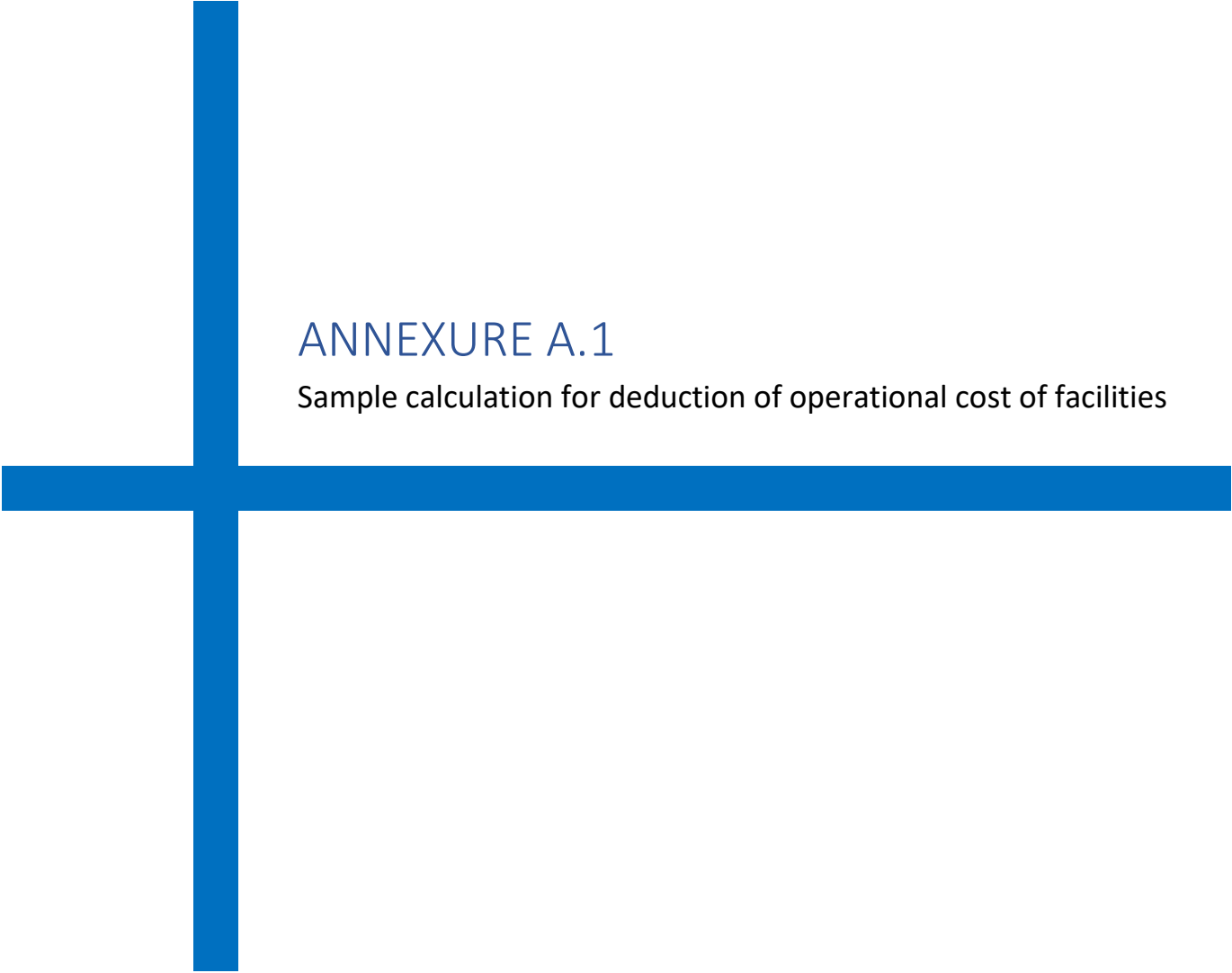
1. When number of workers is <500:
If the distance to a major hospital capable of handling critical injuries expected at Site is ≤ 50 KM from Site, then 1 BLS (Basic Life Support)/ Type B Ambulance otherwise ALS* (Advanced Life Support)/ Type D Ambulance
2. If no. of workers increases to >2000 workers 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

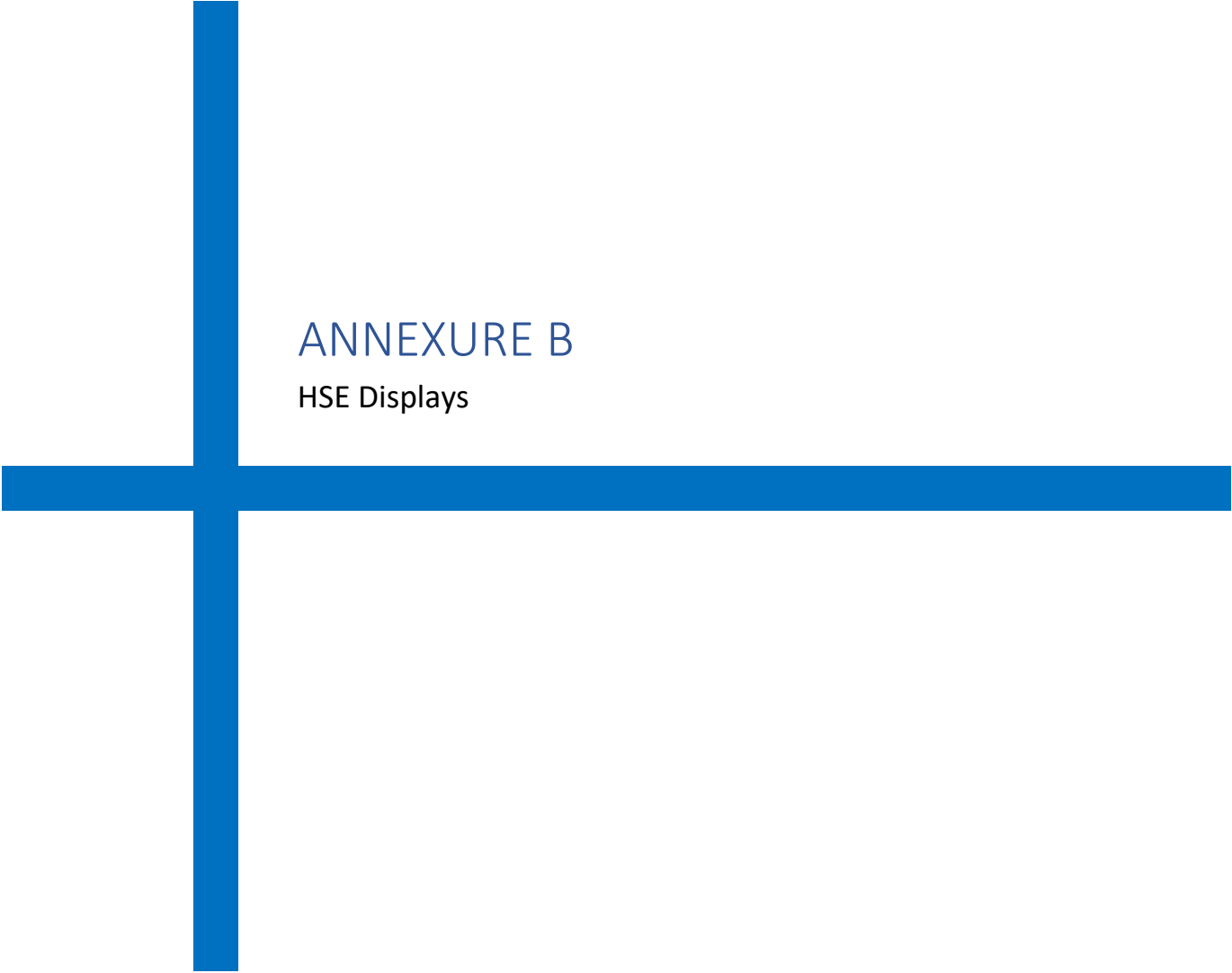
Period (In Months)	6	36	6
	For 1-6 months	For 7-42 months	For 43-48 months
Cost to be incurred from contractors	7%	81%	12%
	1.17% per month	2.25% per month	2.00% per month

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

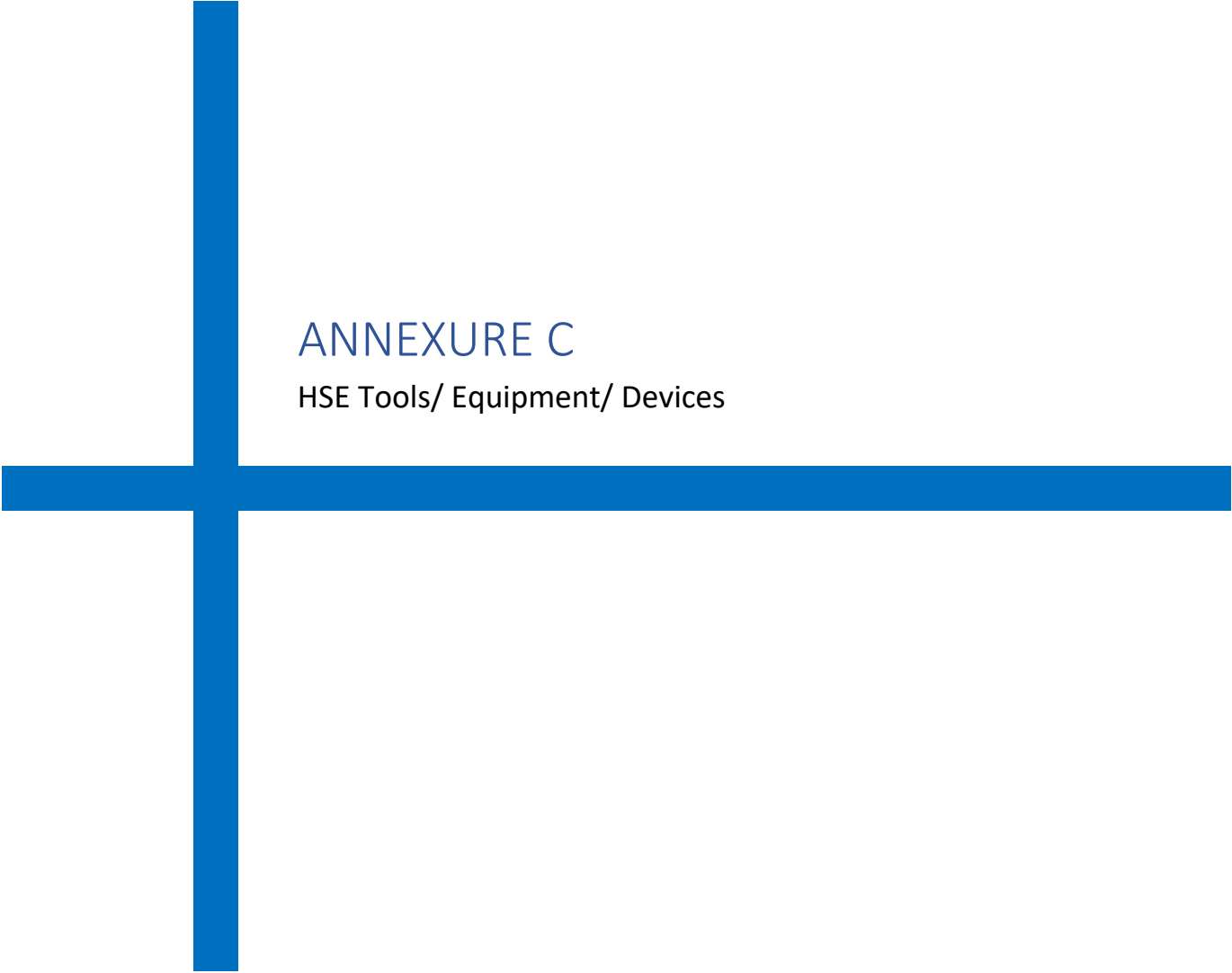
Table 1
(Area/ Package-wise HSE Display Plan – As applicable)

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

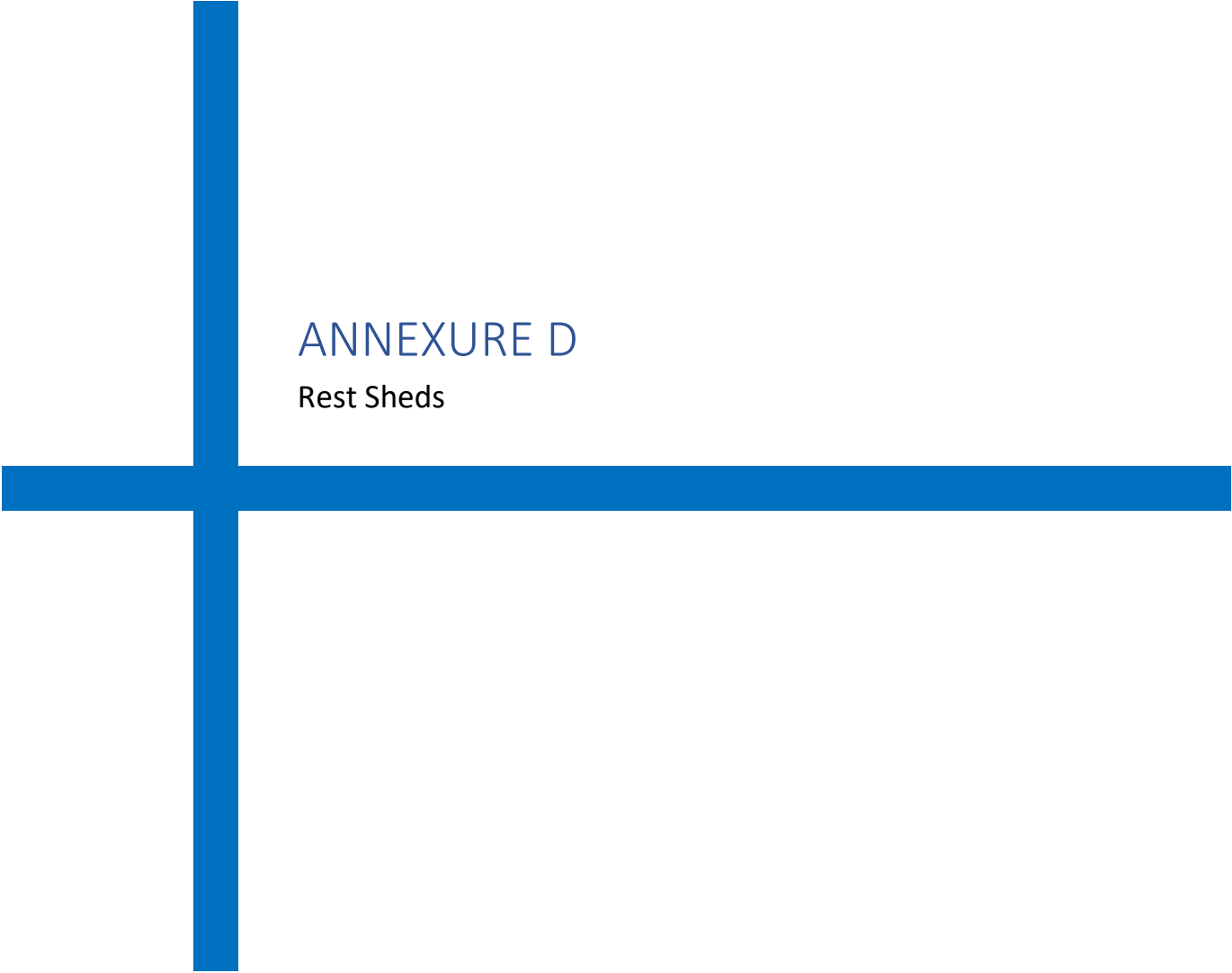
Following equipment conforming to relevant IS/ISO/BS Codes/ Standards in indicated quantities shall be ensured by subcontractor. This list is tentative, not exhaustive. Quantity and date/ period of deployment shall be as per site requirement.

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

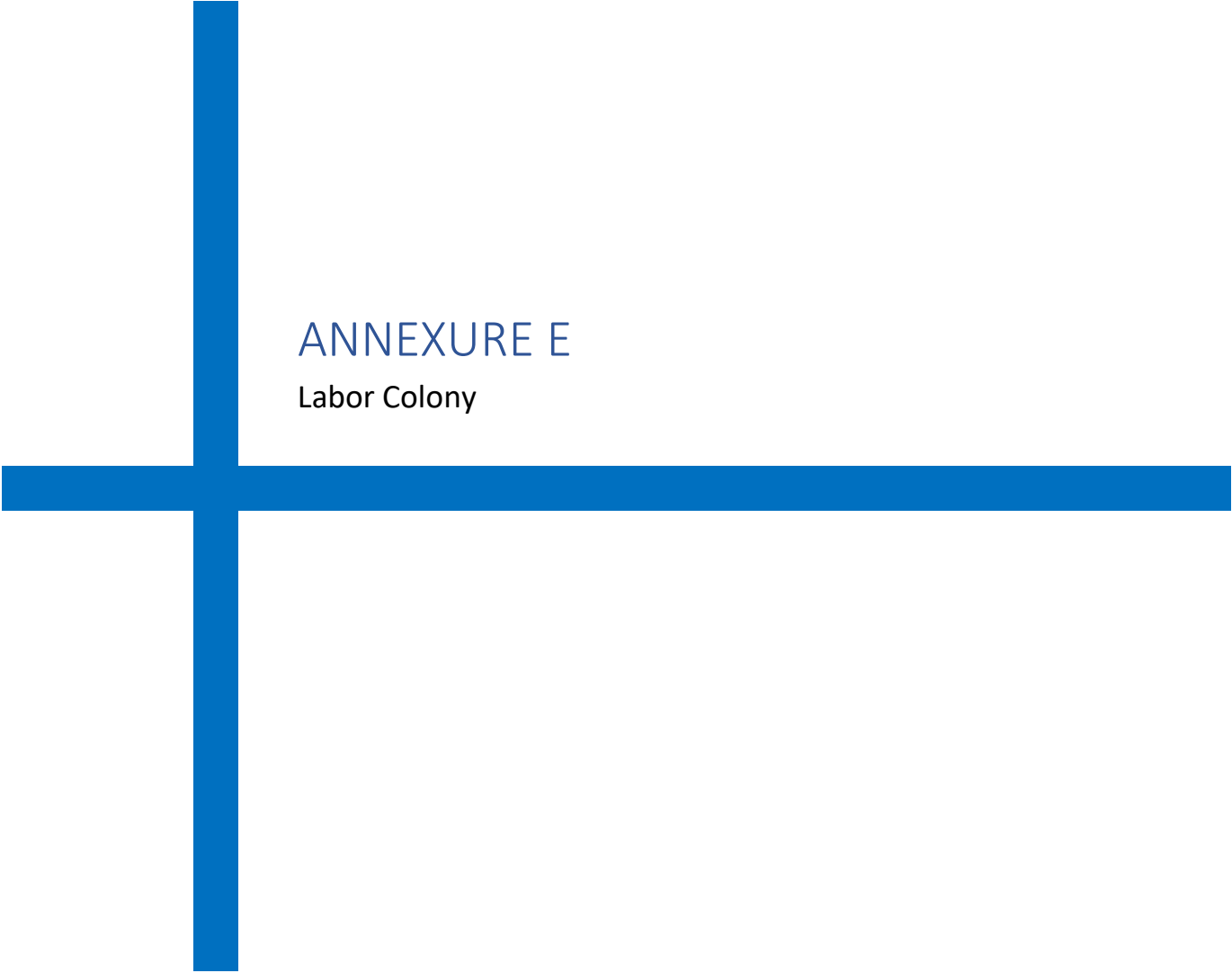
Use of asbestos in construction is banned and shall not be used.

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

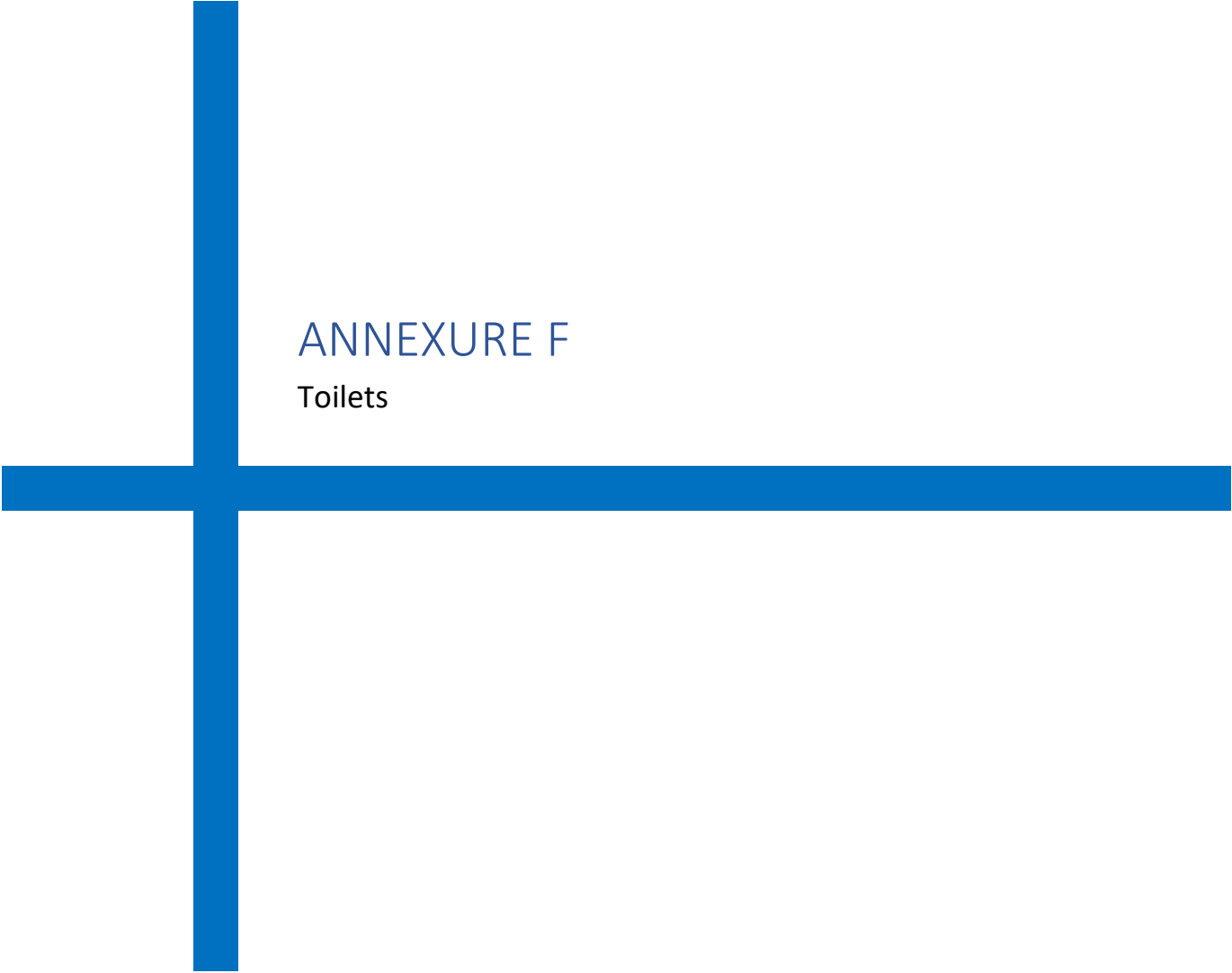
Labor Colony

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

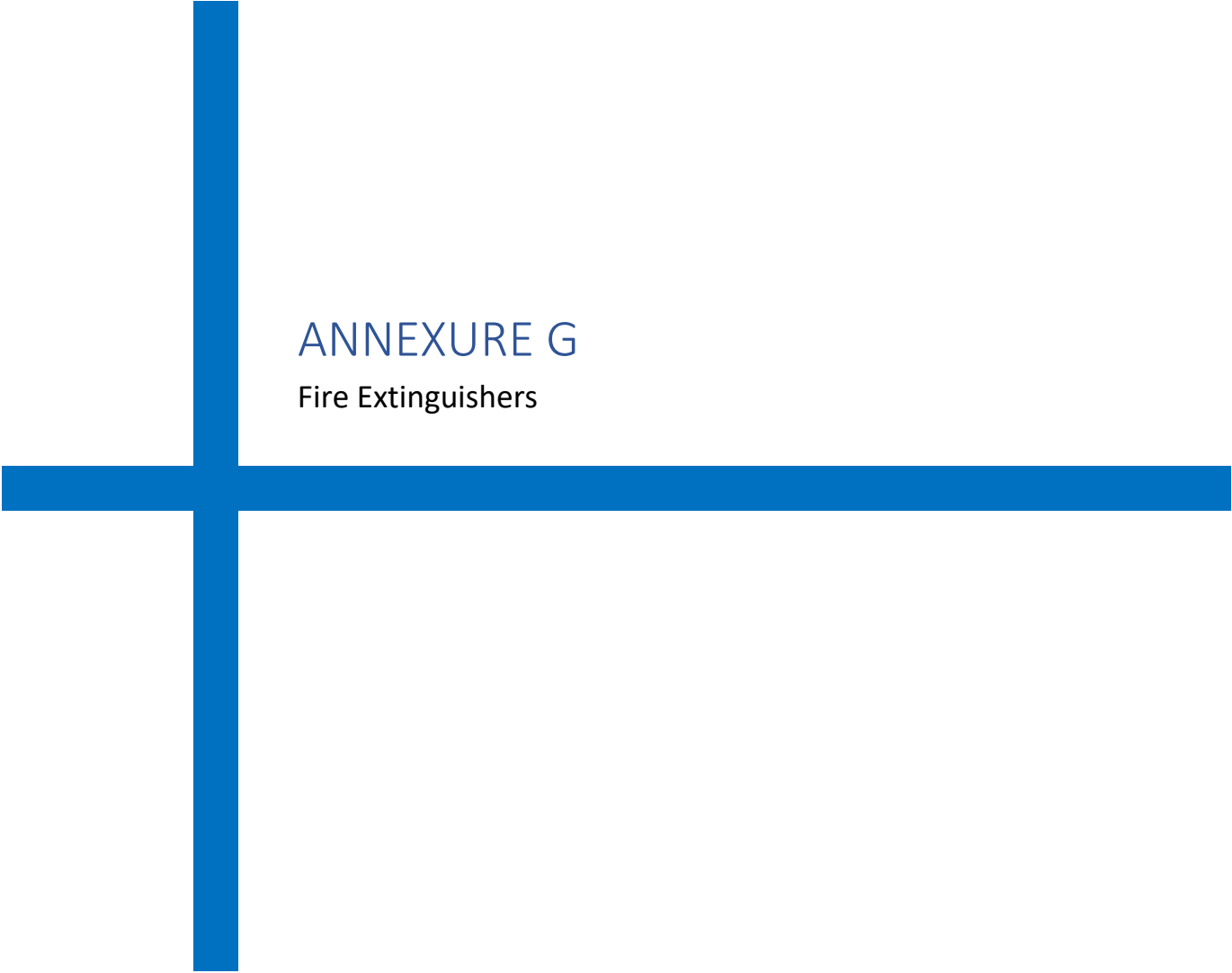
Toilets

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.

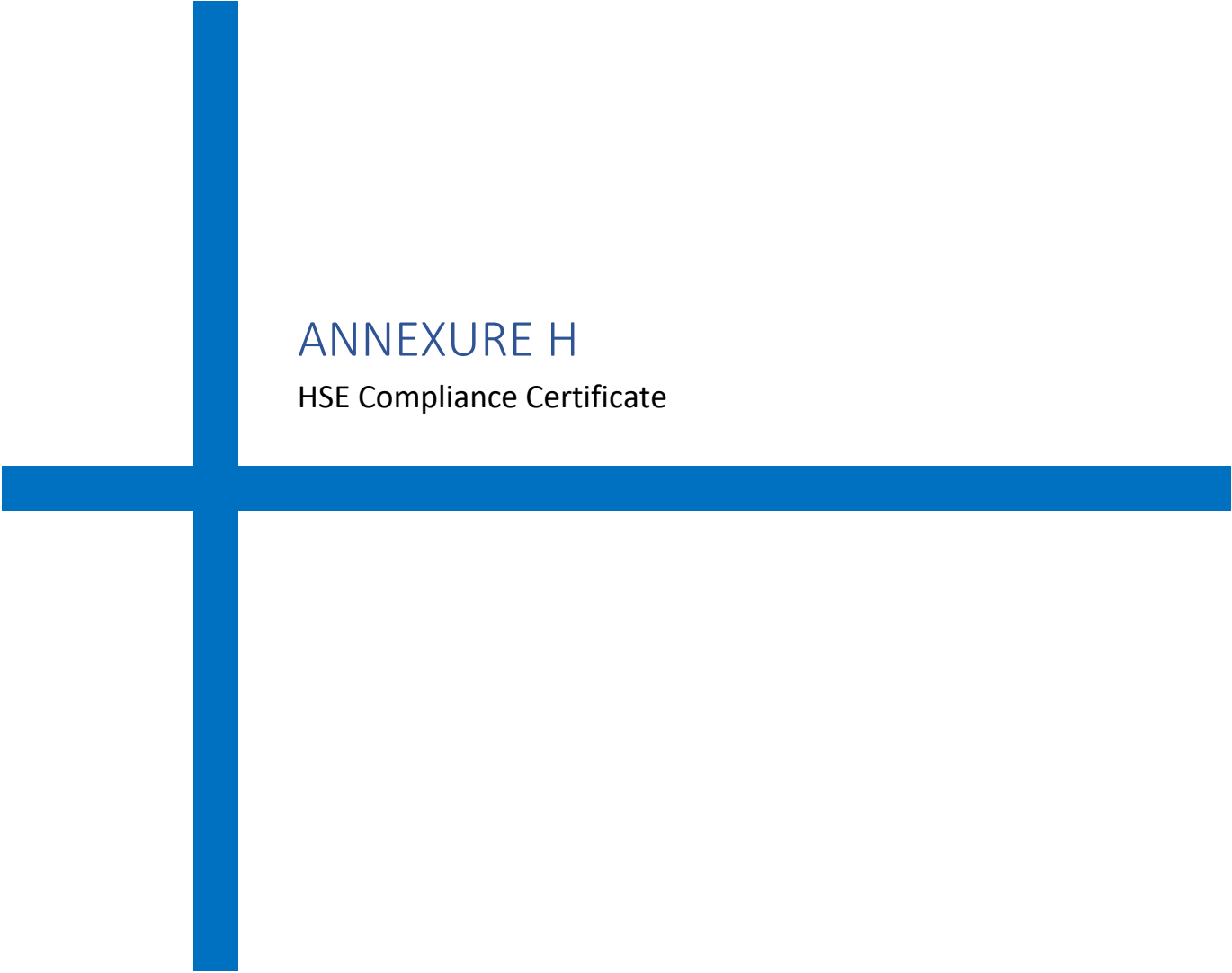
Note: Due to peculiarities of the power plant construction sites, there would be locations in the construction areas of Boiler, Turbine, Generator, Transformer, etc. where different types of fire risk (classes of fire) may co-exist. Special care shall be taken while selecting and installing portable 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

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

- 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

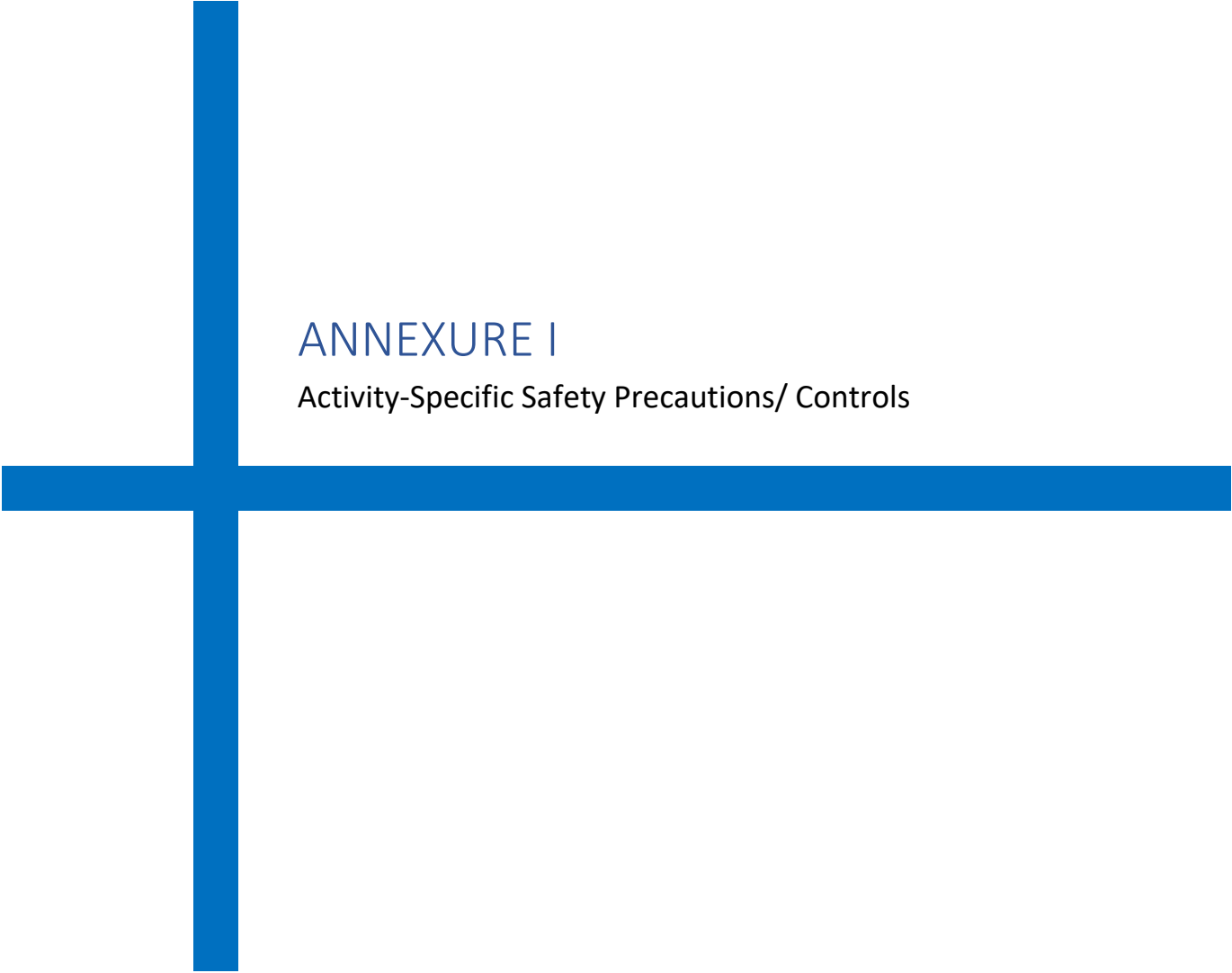
Bill Ref no: _____ Date: _____

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

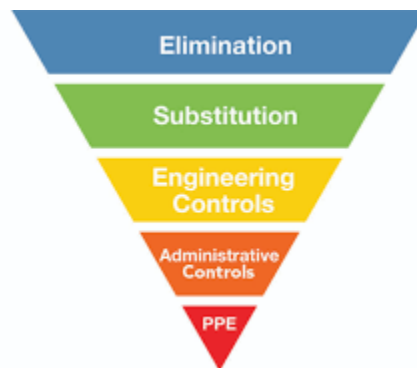


Fig. 1.1

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

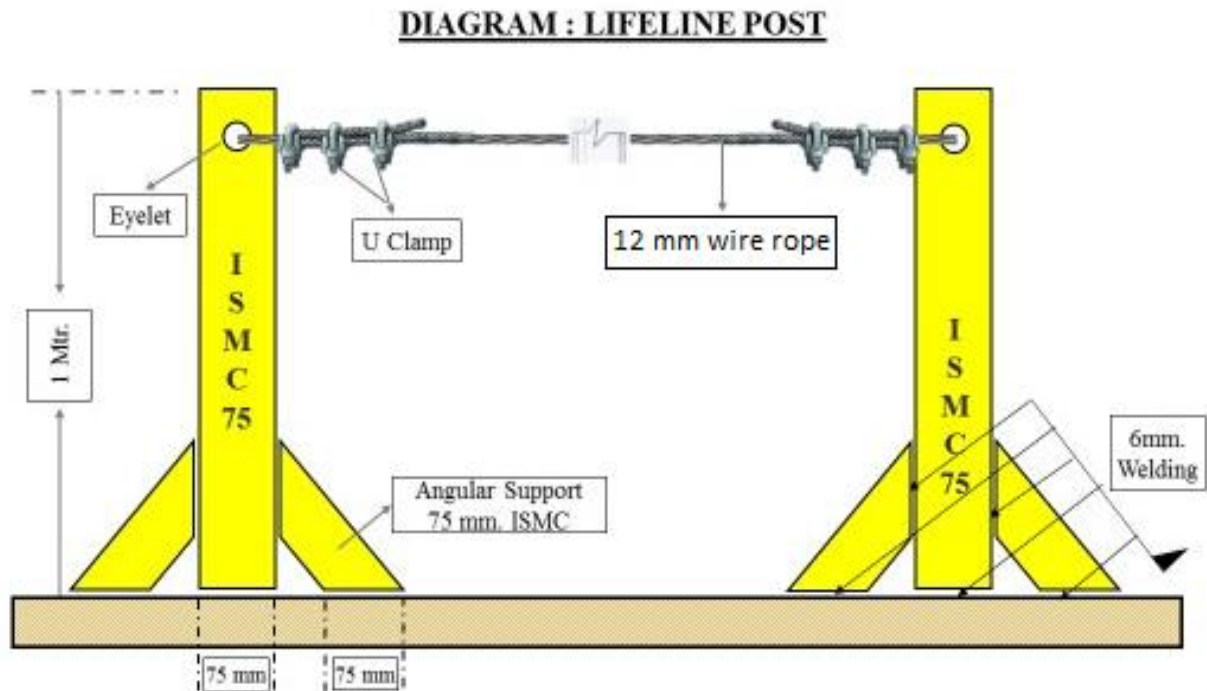


Fig. 2.1 Lifeline Post

- 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.

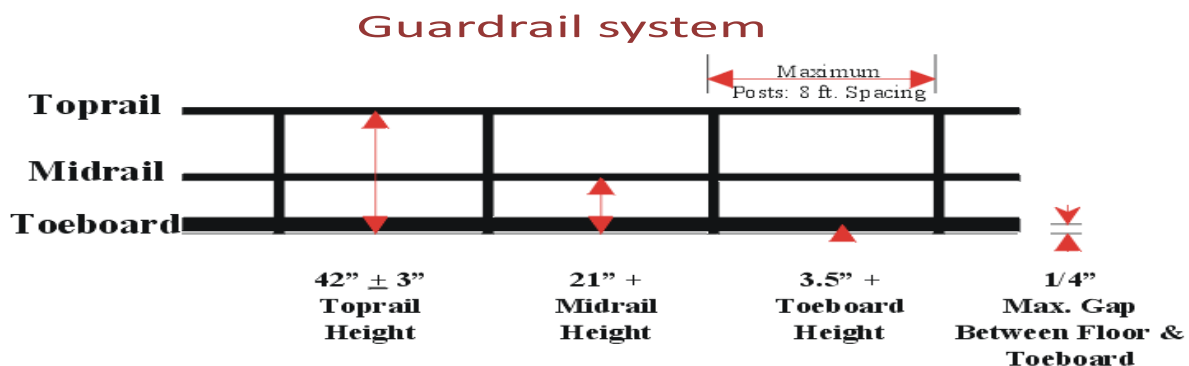


Fig. 2.2 Guard Rail System

- 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.

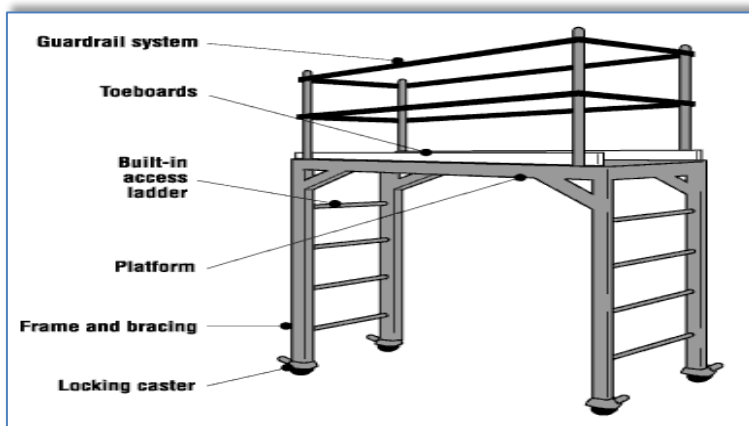
x. Requirements for different types of Scaffolds:

A. Suspended Scaffold

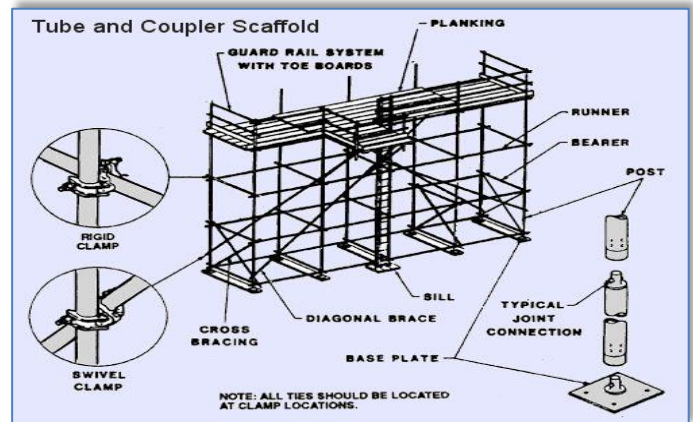
- i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

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 signaler /attendant should be always accompanied with operator/driver for proper direction /signal and also to caution others in the working Zone during operation of mobile plant

2.5 Concrete Vibrators

- a. Revolving parts/belt drives should be adequately guarded and Vibrating unit shall be completely enclosed and have suitable overload relays and effectively earthed
- b. Ensure sufficient length of cable to the Vibrator.
- c. Ensure electric starters and other accessories are firmly fixed adequately supported
- d. Ensure locking of needle load while inserting needle in to the vibrator,
- e. Ensure periodical lubrication and maintenance

2.6 Concrete Mixers

- a. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
- b. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

3. WELDING & GAS CUTTING SAFETY (HOT WORK)

- a. All Hot Work shall require a Hot Work Permit
- b. Inbuilt Voltage Reduction Device (VRD) equipped arc welding machine will only be allowed for work.
- c. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced.
- d. All safety precautions shall be taken for welding and cutting operations as per IS-818.
- e. When possible, items to be welded, cut, heated, etc. shall be moved to a safe location free of combustible or flammable material. If this is not possible, then all combustibles/ flammables that can be removed from the area shall be removed within a 35-foot circumference and a positive means of confining arcs and sparks generated by the process shall be ensured and additional person(s) shall be stationed as fire-watch for the area(s) still exposed, along with obtaining the Hot Work Permit as applicable.
- f. Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times suitable for the type of Fire.

- g. Drums, tanks, and similar containers that have contained flammable or toxic material shall not be welded, cut, or heated until they have been made safe by water filling, thorough cleansing or similar accepted practices. The container shall also be ventilated during the welding, cutting, or heating process.
- h. Proper ventilation is required for any welding or torch operations performed in a confined space.
- i. Any welding or gas cutting operations performed on metals of toxic compounds or coating such as zinc, stainless steel, lead, cadmium, chromium, and beryllium shall be properly ventilated and/or proper respiratory protection shall be worn by any person that could be exposed to fumes, vapors, and gasses created by the welding and gas cutting processes.
- j. Wherever it is practical, all arc welding operations shall be shielded to prevent direct light rays or sparks from contacting persons in the vicinity or from reaching areas normally used to travel through or into the vicinity. Where this is not practical, persons who shall be in the area are to use proper eye and skin protection. Other persons who are not participating in the welding or gas cutting operations are not to be allowed into the hazard zone.
- k. Welders and other employees who are exposed to arc welding radiation shall wear suitable clothing and protective apparel to prevent burns and other types of ultraviolet radiation damage to the skin.
- l. Arc welding machines shall be shut down when being moved or when they are not in continuous use. Electrode holders left unattended shall have electrodes removed and shall not be left where they might contact employees or conducting objects.
- m. Arc welding power supply cable shall be of proper rating and material, e.g. copper.
- n. Welders shall guard against allowing materials adjacent to or behind them to reflect radiation back toward them or towards others in the area. Reflected radiation can cause skin burns and eye flash burns.
- o. Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
- p. Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot-work.
- q. **Splatter / Slag Collector:**

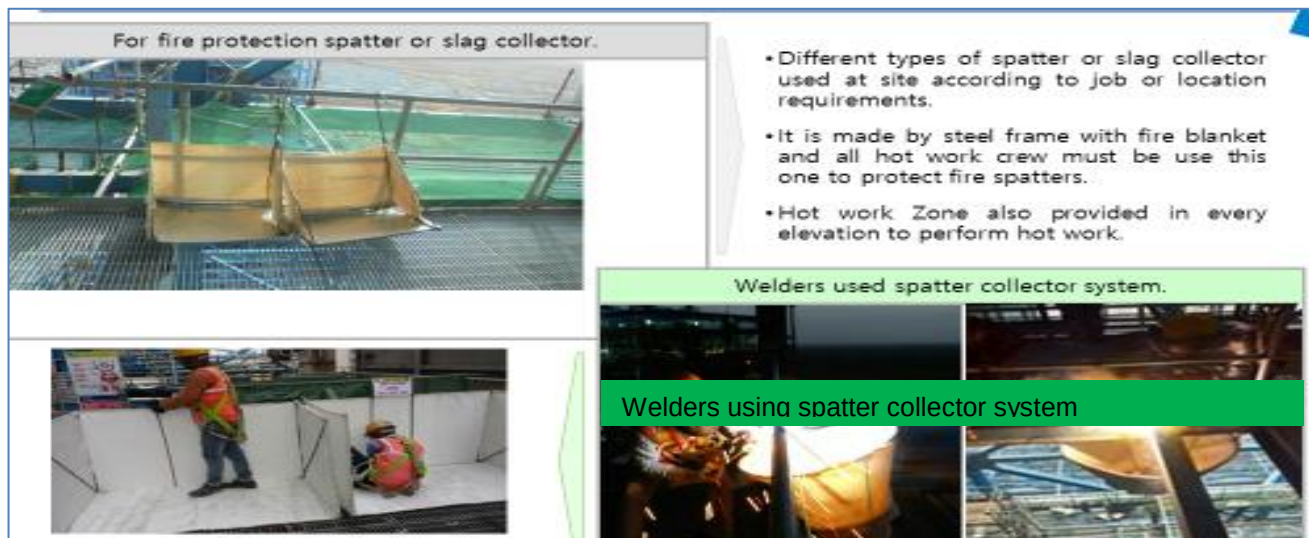


Fig. 4.1 Splatter / Slag Collector

While carrying out job at height, the sparks or molten slag shall be prevented from falling down by putting a fire-resistant (non-asbestos) sheet or patter/ slag collector or even MS Sheet. The passage of falling sparks

or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passages 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.

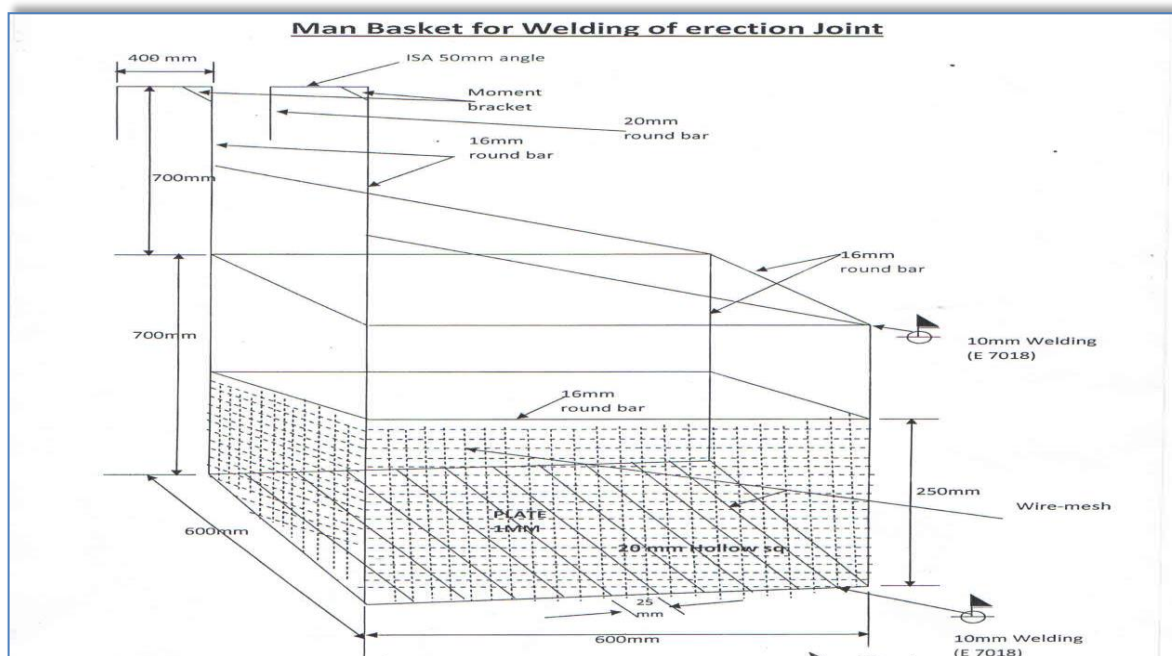


Fig. 5.1 Man Basket for Welding Erection Joint

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.

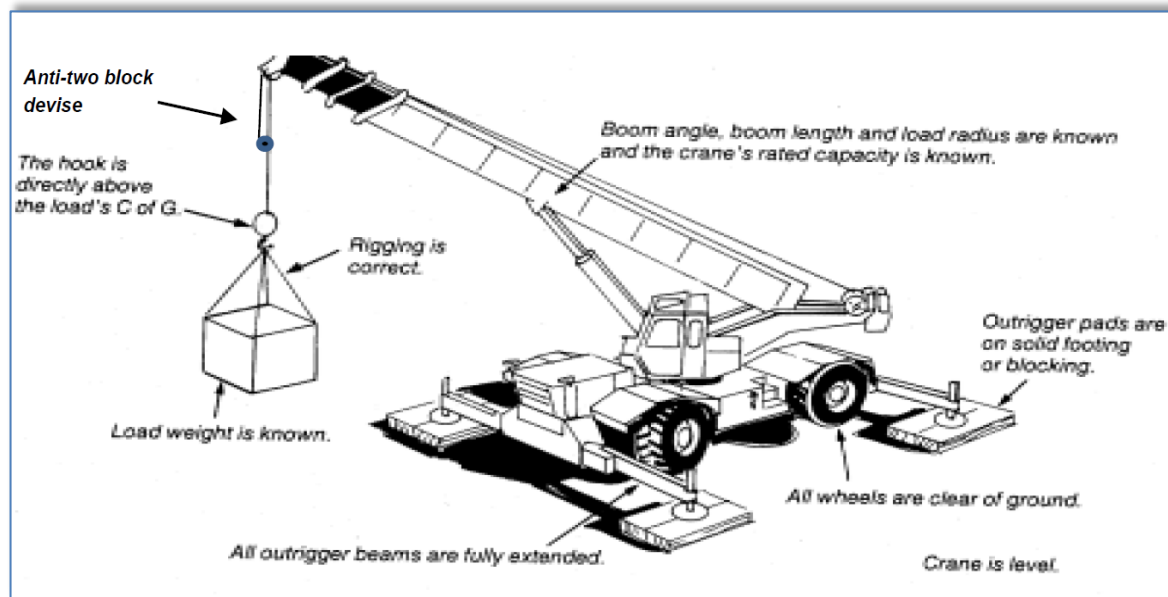


Fig. 5.2 Proper Crane Setup

- 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.

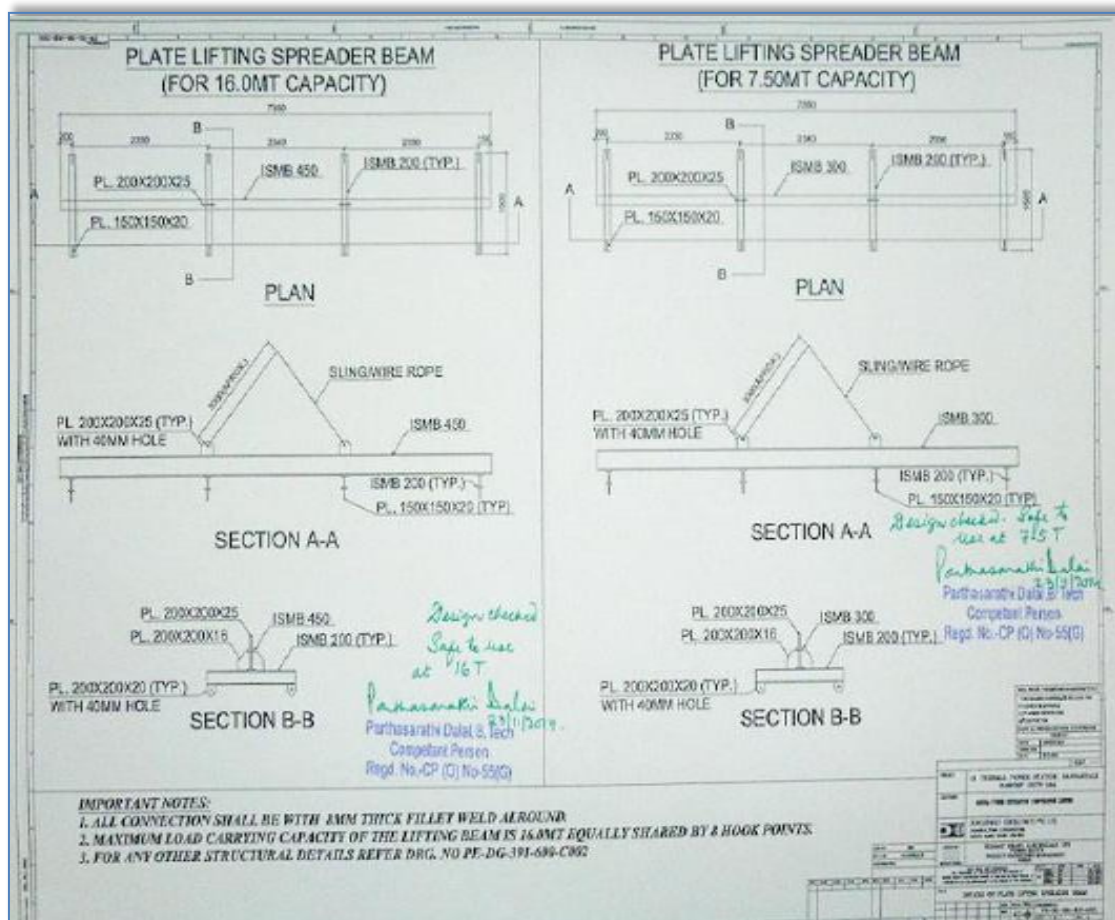


Fig. 5.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads

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.

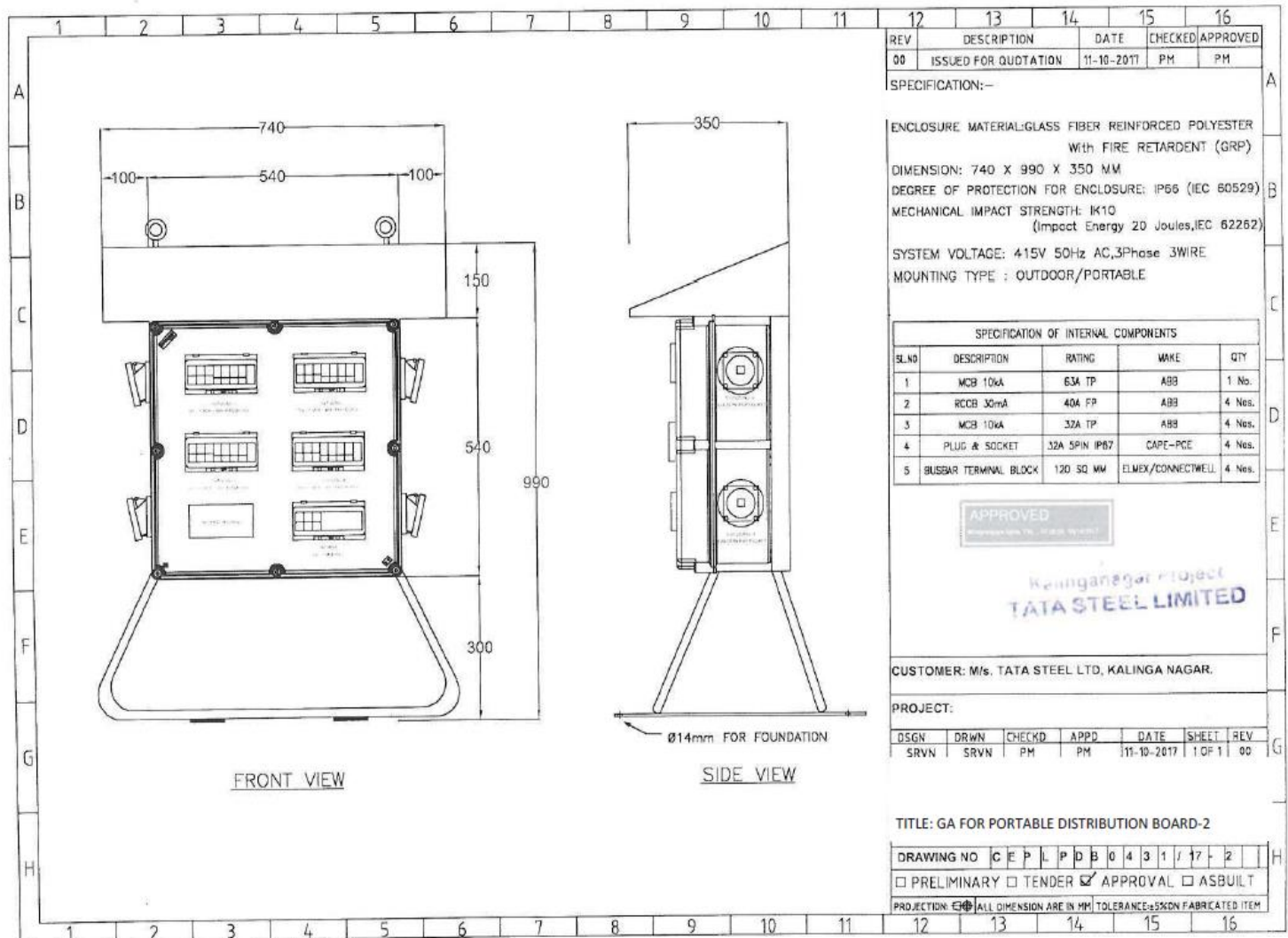


Fig. 9.1 Layout of a modern Power Distribution Board

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

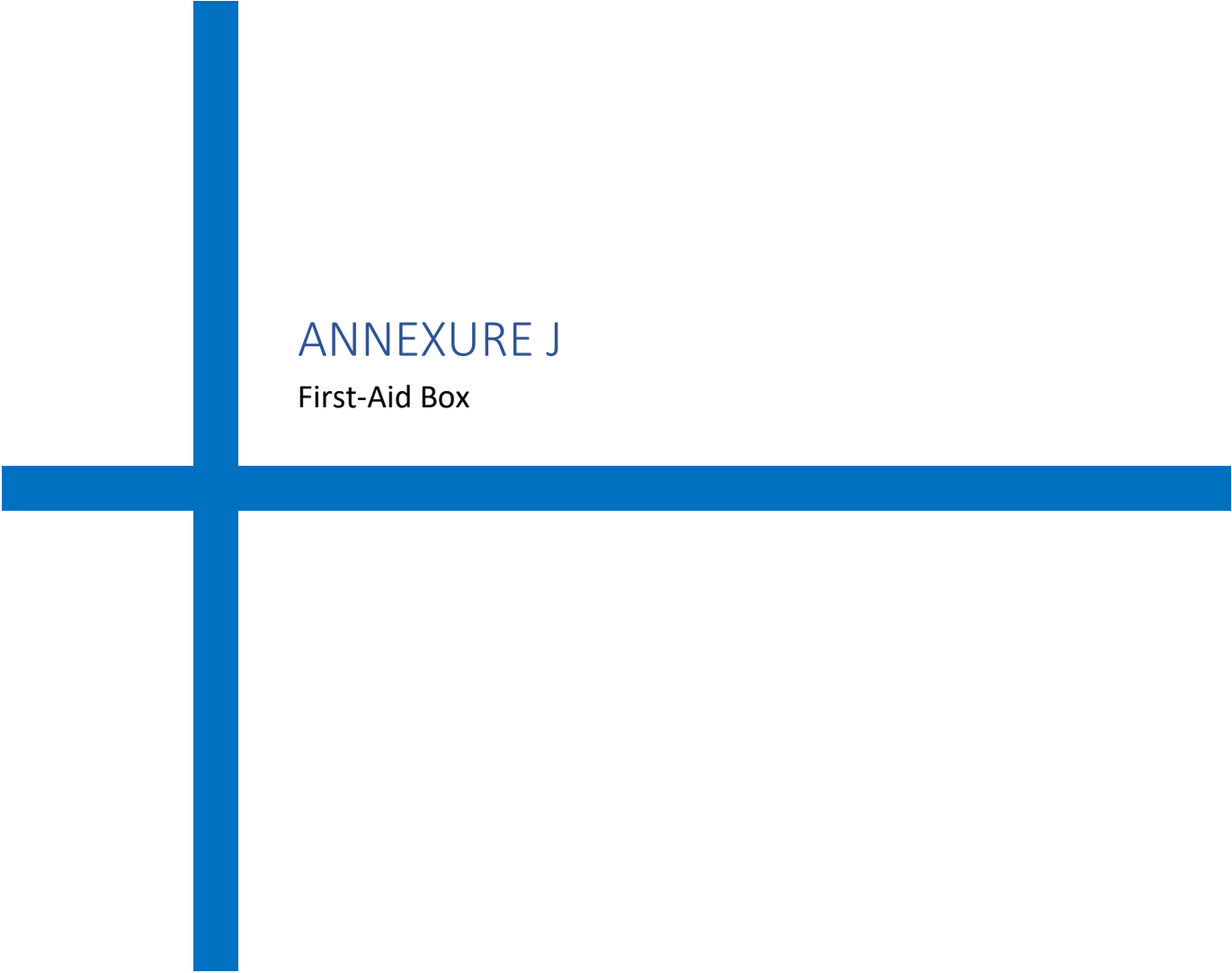
15.5 Noise Mitigation

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:

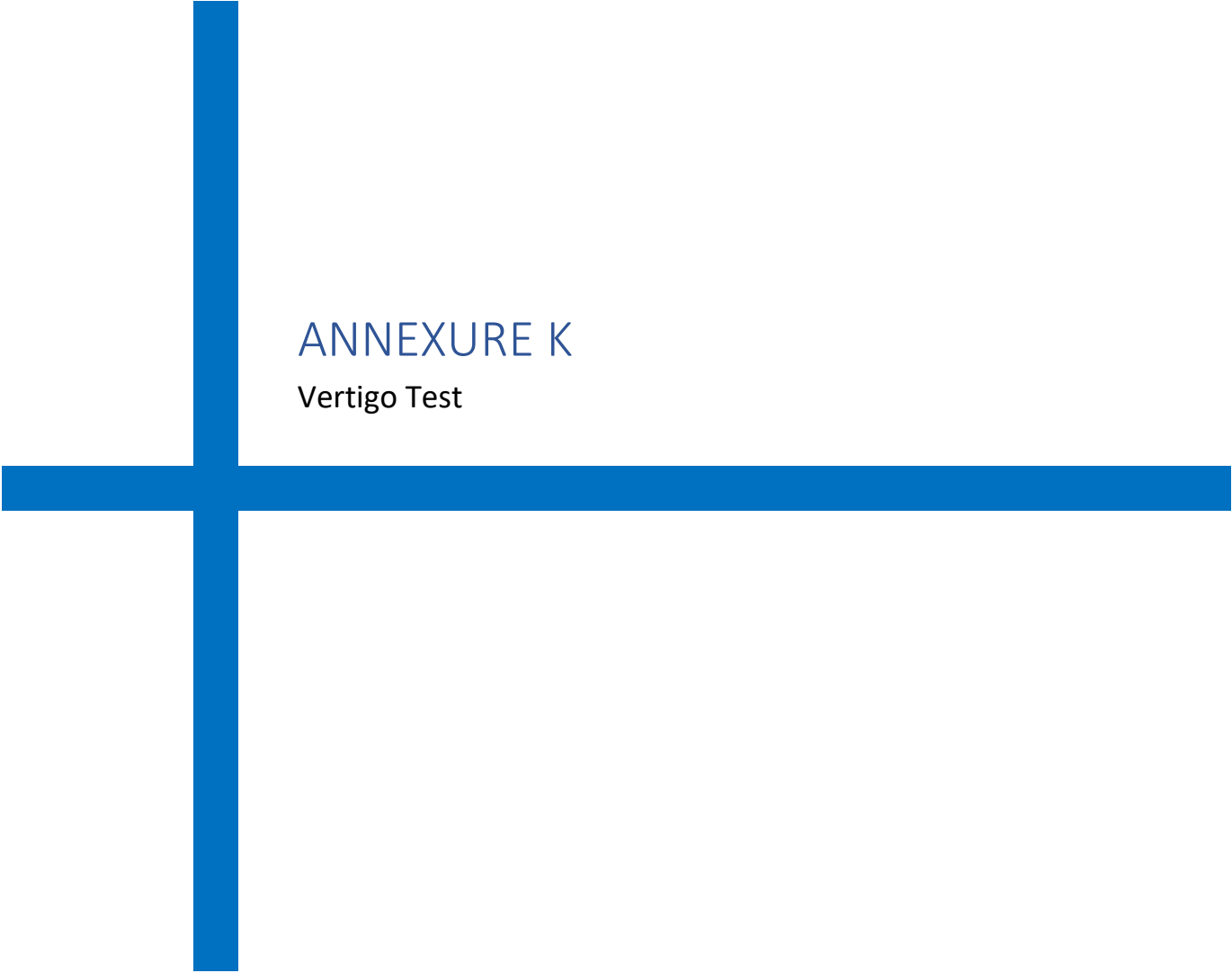
(a) For establishments in which the number of contract labor employed does not exceed fifty, each first aid box shall contain the following equipment:

(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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART-II CHAPTER 6 DRAWINGS & SCHEMES

2.6. THE FOLLOWING ENCLOSED DRAWINGS ARE FOR INFORMATION ONLY

Sl No	Details	No. of sheets
1	HMI Configuration Drawings for Unit 3 & 4	16
2	Write Up for C&I & Mechanical Lab Equipment (Unit 3 & 4)	32

HMI CONFIGURATION DIAGRAM

PROJECT : YADADRI TPS, NALGONDA (5 x 800 MW)

WBS No. : CE/1276-SH1-56-01

TO

CE/1276-SH5-56-01

CE/1276-SHC-56-01

BHEL DRG. No. : EN-DG-1276-145-4001

TATA CONSULTING ENGINEERS LIMITED			
VENDOR DOCUMENT REVIEW STATUS			
☒ A	Drawing/Document approved as submitted. Proceed with fabrication/construction.		
☐ B	Drawing/Document approved subjected to comments noted. Proceed with fabrication/construction considering our comments.		
☐ C	Our comments are noted on this marked up print.		
☐ D	Our comments are noted in memo attached to the forwarding transmittal letter No. TCE 11005A-IC-V01-276. Dated 27-01-2020		
☐ E	Correct original of this drawing/document to reflect our comments and resubmit for approval.		
☐ F	Correct original of this drawing/document to reflect our comments and resubmit for records.		
☐ G	Drawings/Documents of this category are for information only and not for approval. Information furnished on the drawing/document is noted.		
☒ H	Drawing/Document reviewed against our previous comments and other revisions highlighted and identified by the vendor.		
☐ I	Drawing/Document returned without review.		
☐ J	Print not enclosed.		
Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance requirements and conformity of the supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchaser's rights under the contract.			
Reviewed by.....NC.....Date.....27-01-2020			

THIS DOCUMENT SHOULD BE READ ALONG WITH :

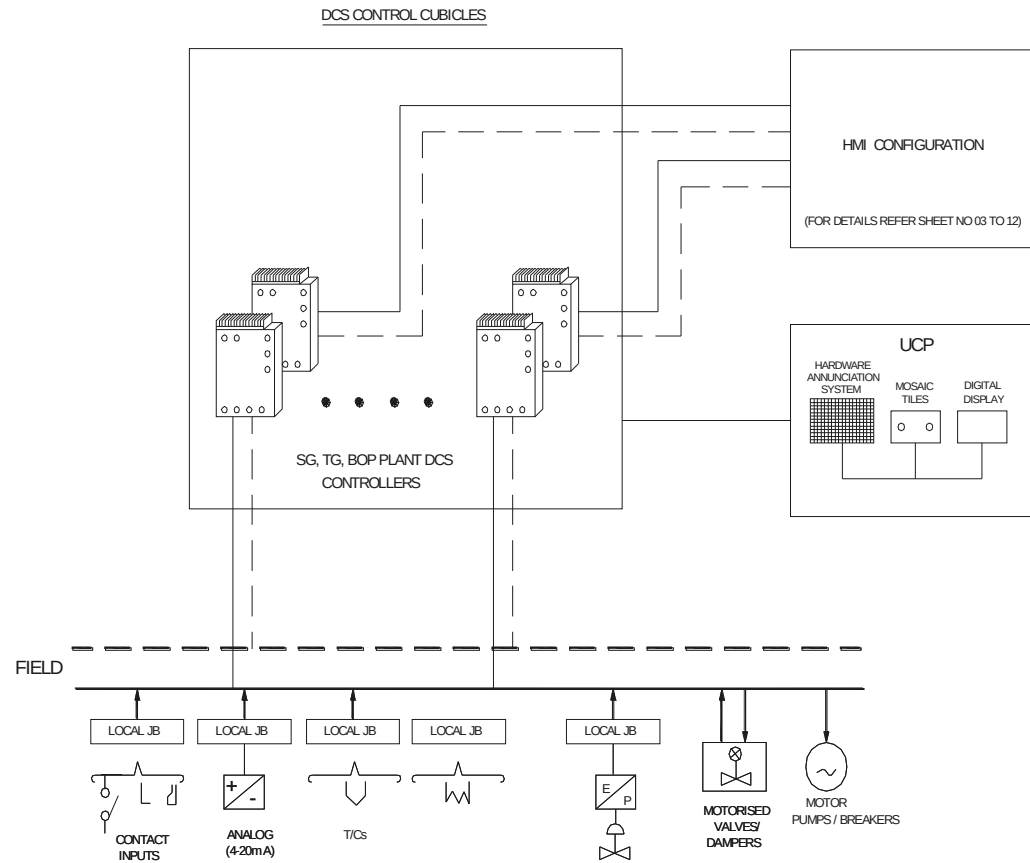
1. FUNCTION GROUPING DOCUMENT (EN-DG-1276-145-5001)AND
2. CONTROL SYSTEM FOR MECHANICAL AUXILIARIES PACKAGES (PE-DM-417-145-I900)

JOB NO.	417
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

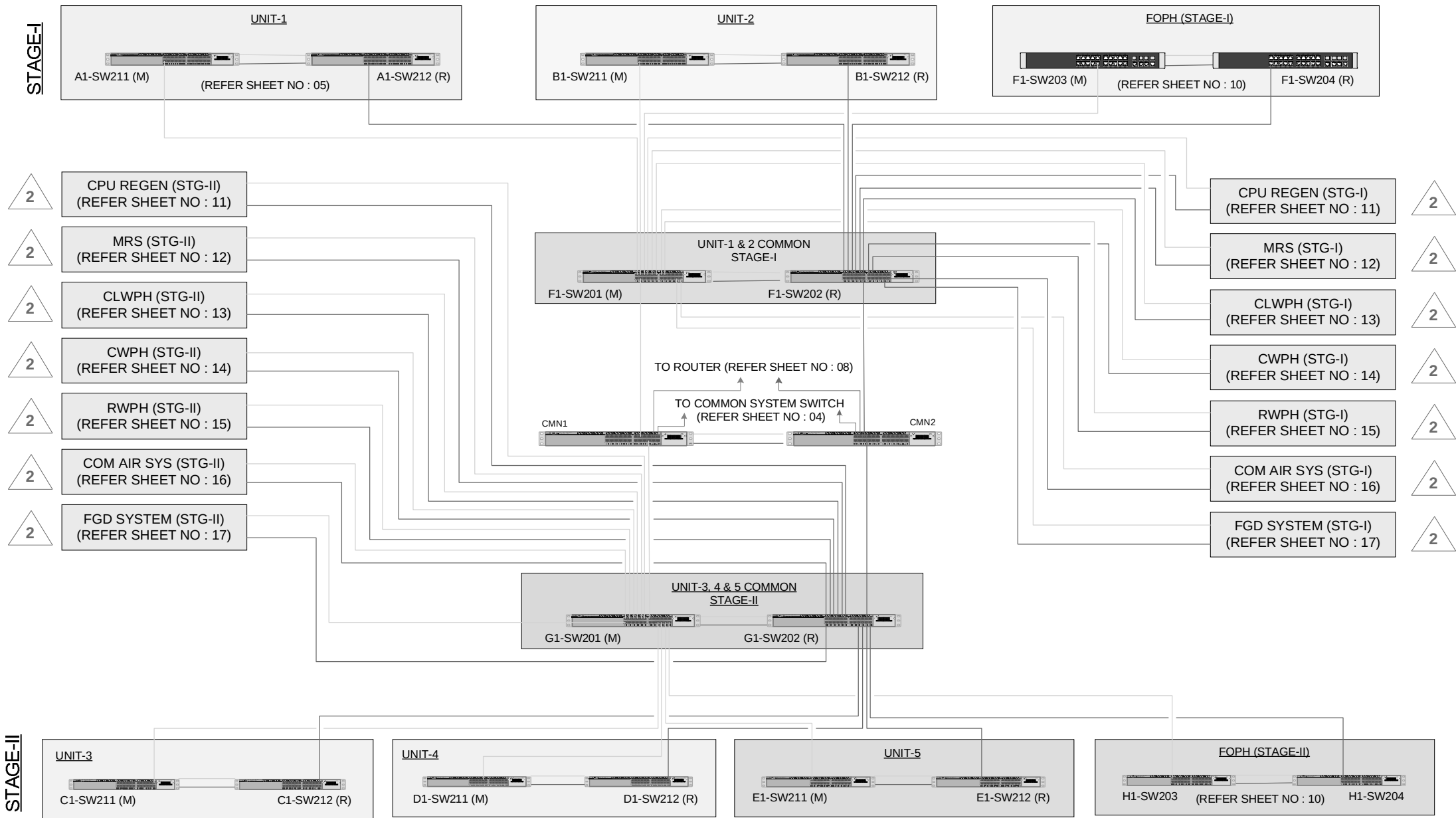
CUSTOMER	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, NALGONDA												
CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE INDIA												
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA												
COPY RIGHT AND CONFIDENTIAL. The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.										DEPT CODE C	NAME BHASKAR ABHISHEK REETESH	SIGN	DATE 01.03.19 01.03.19 01.03.19
TITLE HMI CONFIGURATION DIAGRAM													
										DEPT.	SCALE	DRAWING NO. EN-DG-1276-145-4001	
										SIGN		SHEET 01 OF 21	
												REV. 02	

OVERALL DCS CONFIGURATION FOR UNIT-1 TO UNIT-5



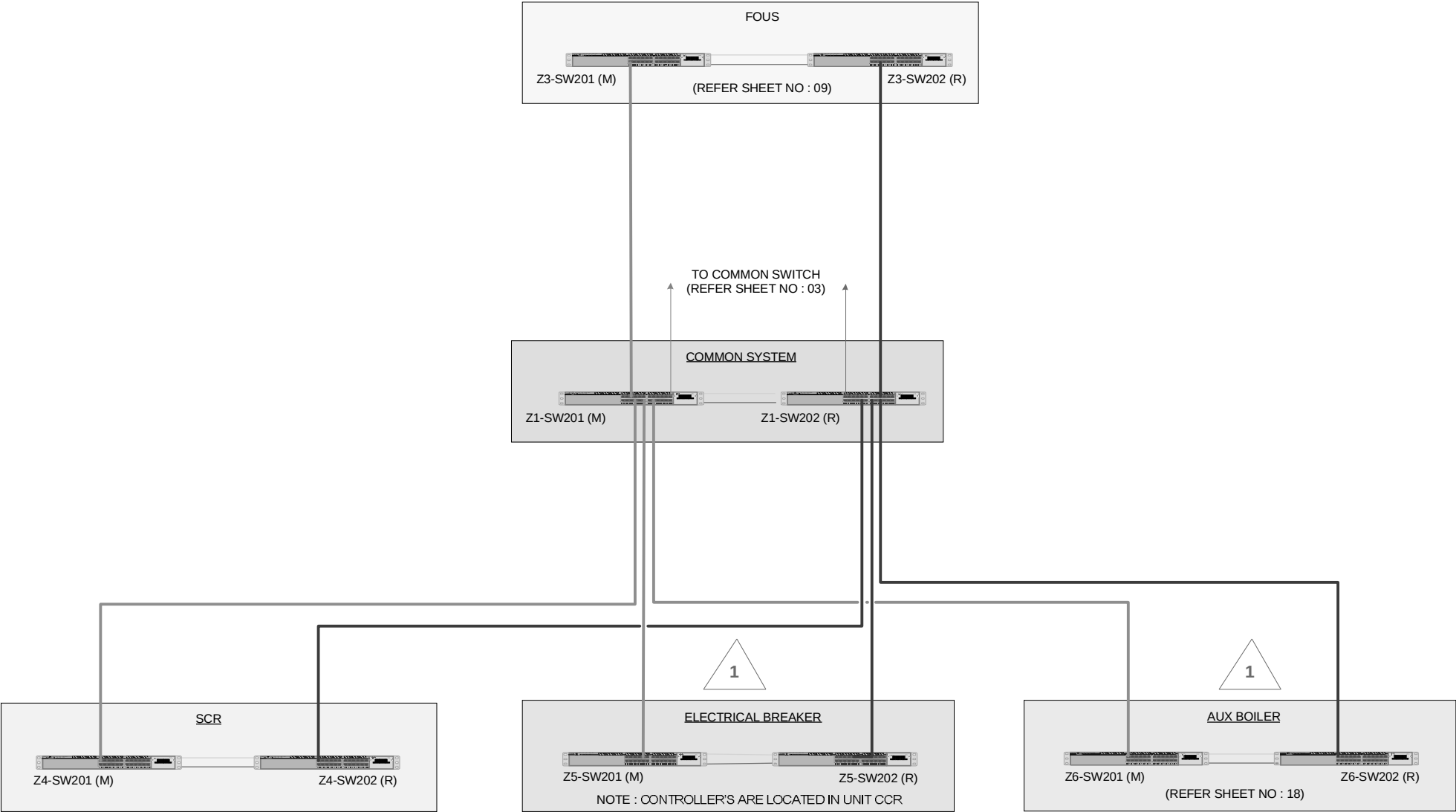
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										BHEL		OBJECT									
												MODEL									
DATE		NAME		APPD		REVISION				REV.NBR		TITLE									
DESIGN.		BHASKAR \ 01-03-2019		CHKD		REETESH \ 01-03-2019		APPD		ABHISHEK \ 01-03-2019		OVERALL DCS CONFIGURATION FOR UNIT-1 TO UNIT-5									
FILE				APPLA						PROD.		HMI System				DCC		DRAWING ID/REV		SHEET	
																		EN-DG-1276-145-4001		02 02 (21)	

HMI CONFIGURATION DIAGRAM OVERVIEW



						Valmet BHEL	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER					
							OBJECT						
							MODEL						
DATE	NAME	APPD	REVISION			REV.NBR	TITLE HMI CONFIGURATION DIAGRAM OVERVIEW			DCC	DRAWING ID/REV EN-DG-1276-145-4001	SHEET 02	03 (21)
DESIGN.	BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD							
FILE				APPLA			PROD.	HMI System					

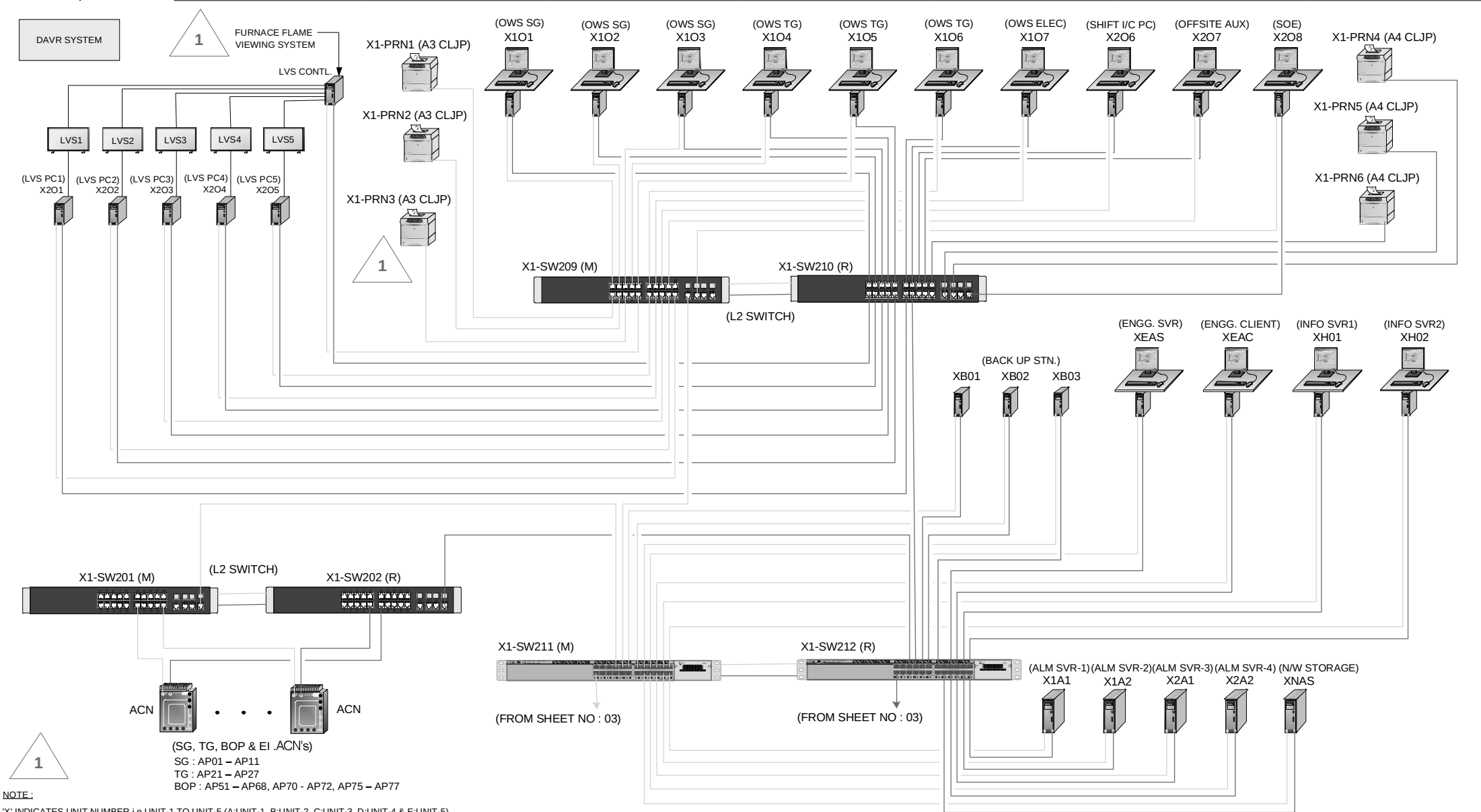
HMI CONFIGURATION DIAGRAM OVERVIEW



AHP & CHP REMOVED

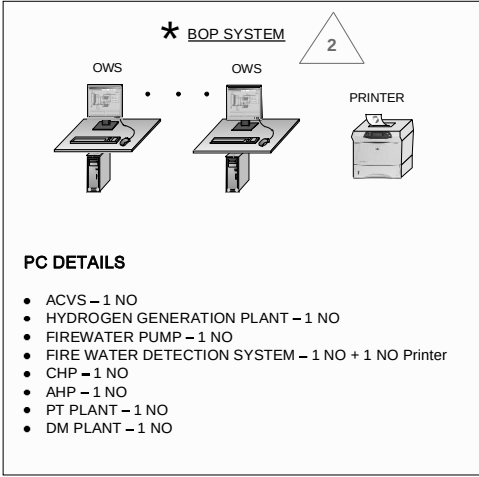
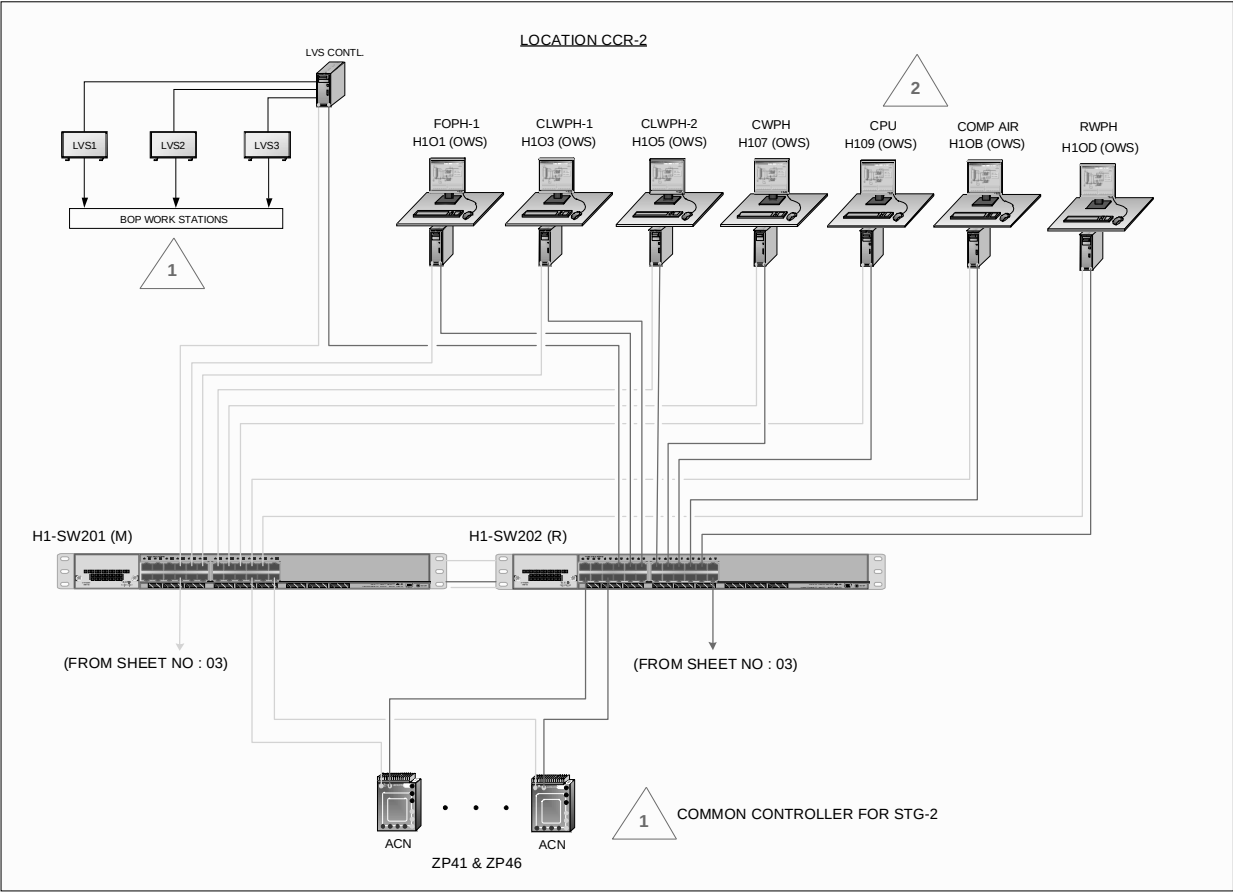
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								OBJECT						
								MODEL						
DATE		NAME	APPD	REVISION			REV.NBR		TITLE HMI CONFIGURATION DIAGRAM OVERVIEW					
DESIGN.		BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD REETESH \ 01-03-2019							
FILE				APPLA										
				PROD.		HMI System				DCC	DRAWING ID/REV EN-DG-1276-145-4001		SHEET 02	04 (21)

HMI CONFIGURATION FOR UNIT-1 TO UNIT-5 - CCR



NOTE :
'X' INDICATES UNIT NUMBER i.e UNIT-1 TO UNIT-5 (A:UNIT-1, B:UNIT-2, C:UNIT-3, D:UNIT-4 & E:UNIT-5)
ETHERNET SWITCHES & CONTROLLERS ARE INDICATIVE
FOR CONTROLLER DETAILS PLEASE REFER PARTIONING / CONTROLLER GROUPING DOCUMENT
REMOTE I/O FOR (AP64, AP65) IS CONNECTED THROUGH FO CABLE IN CWPH
UNITIZED CPU IS LOCATED IN SERVICE VESSEL AREA

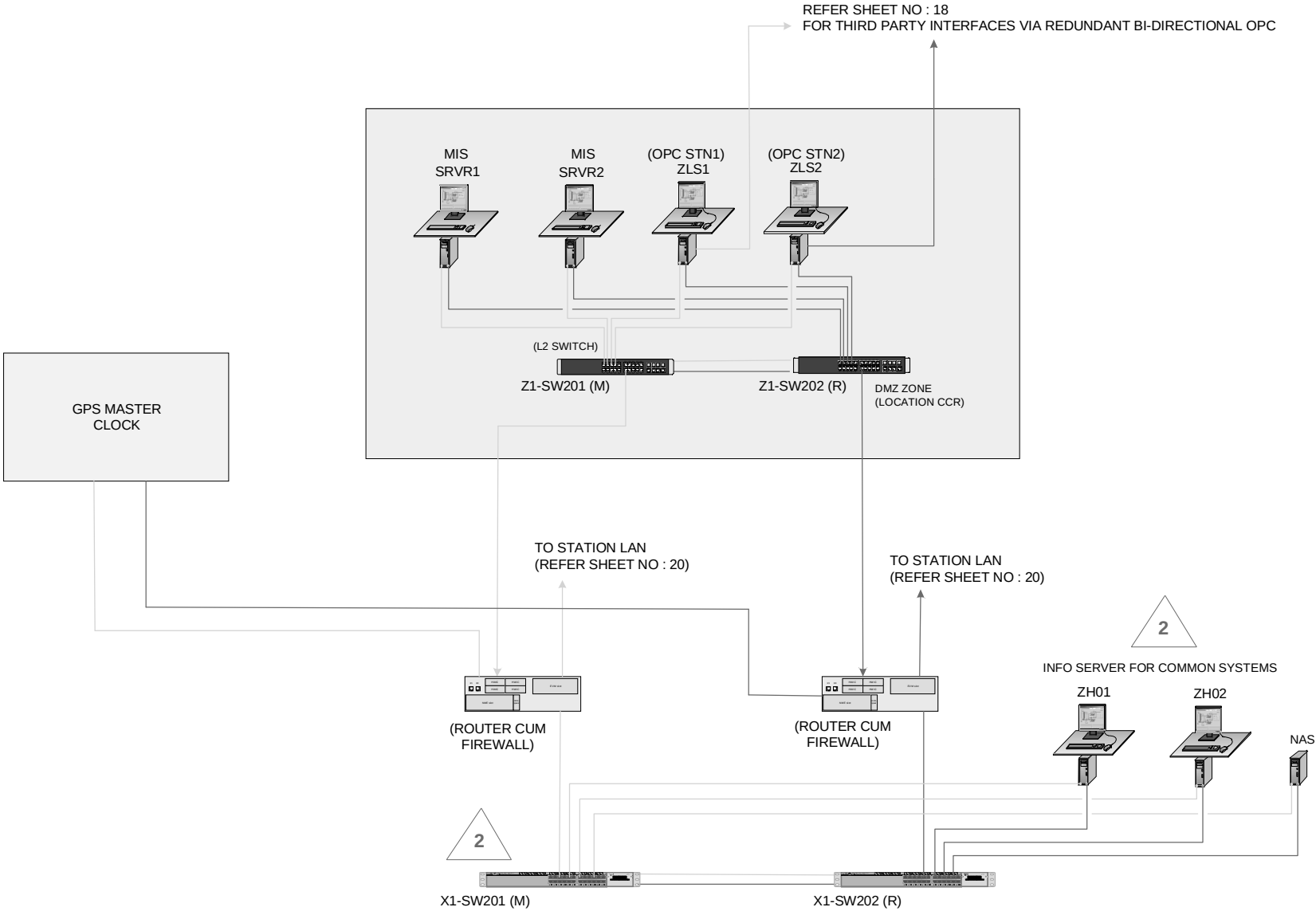
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							OBJECT					
								MODEL	CUSTOMER DWG NR			
DATE	NAME	APPD	REVISION			REV.NBR	TITLE HMI CONFIGURATION FOR UNIT-1 TO UNIT-5 - CCR					
DESIGN. BHASKAR \ 01-03-2019		CHKD ABHISHEK \ 01-03-2019	APPD REETESH \ 01-03-2019									
FILE			APPLA			PROD. HMI System				DCC DRAWING ID/REV EN-DG-1276-145-4001		
							SHEET 02 05 (21)					



★ UNDER RESPECTIVE BOP VENDOR SCOPE. HOWEVER, DESK WILL BE SUPPLIED BY BHEL-EDN
FOR CONTROLLER DETAILS PLEASE REFER PARTIONING / CONTROLLER GROUPING DOCUMENT

						 	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER				
							OBJECT					
								MODEL				
DATE	NAME	APPD	REVISION			REV.NBR	TITLE					
DESIGN.	BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019					HMI CONFIGURATION (COMMON SYSTEM UNIT-3 & UNIT-4) - CCR
FILE				APPLA		PROD.	HMI System		DCC	DRAWING ID/REV		SHEET
								EN-DG-1276-145-4001		02	07 (21)	

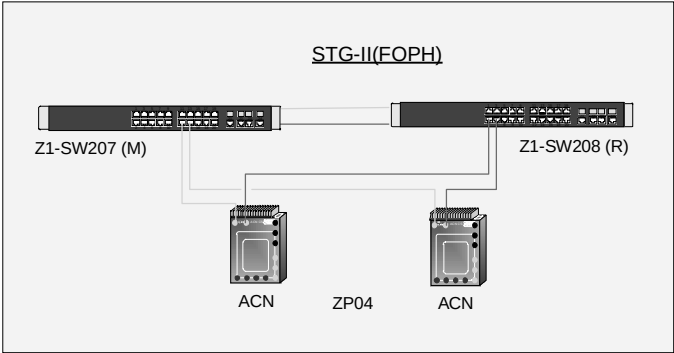
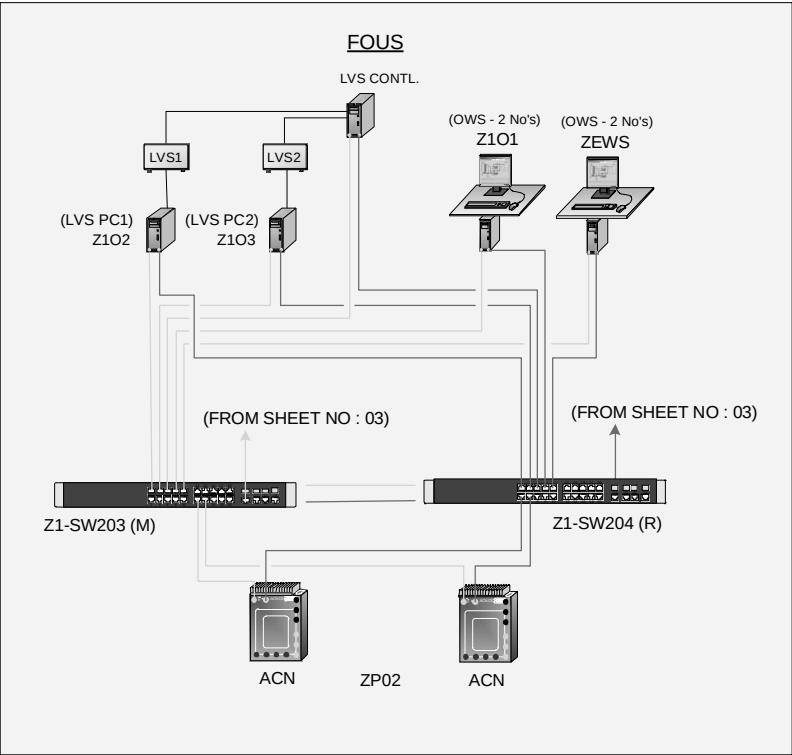
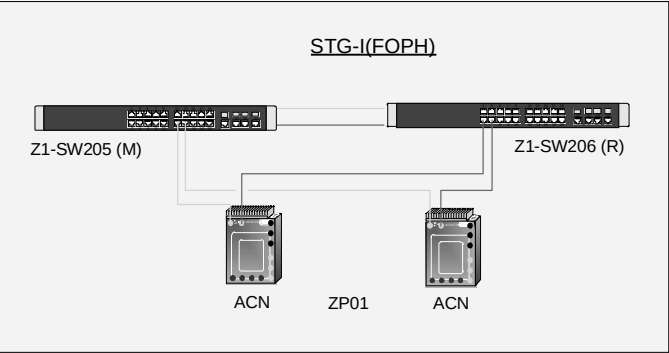
HMI CONFIGURATION COMMON FOR 5 UNITS



OPC stations are part of Unit 1 HMI & will be placed in Unit 1 CER

					 	PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER			
						OBJECT						
						MODEL						
DATE	NAME	APPD	REVISION		REV.NBR	TITLE HMI CONFIGURATION COMMON FOR 5 UNITS				DCC DRAWING ID/REV EN-DG-1276-145-4001_02 SHEET 09 (21)		
DESIGN.	BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019								
FILE			APPLA			PROD.		HMI System				

HMI CONFIGURATION FOR FOUS AND FOPH (LCR)



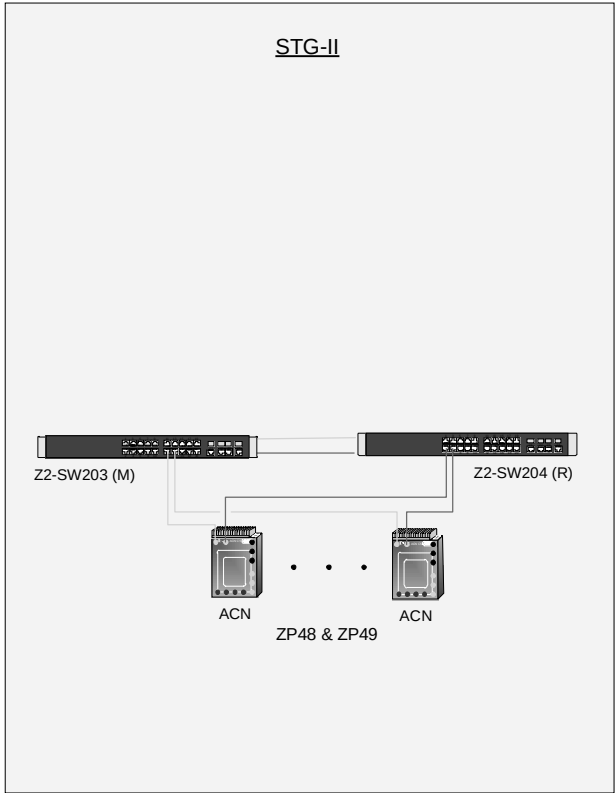
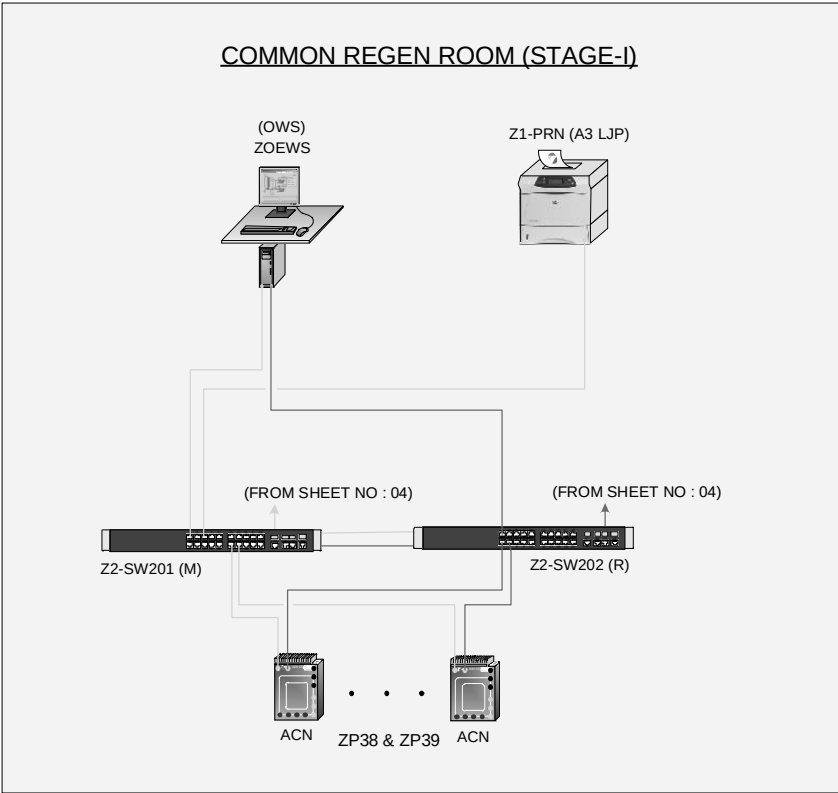
NOTE :
HFO TRUCK UNLOADING AND LDO TRUCK UNLOADING IS IN MAIN CONTROLLER WITH MIMIC AND BACKUP PANEL
#RIO AT HFO UNLOADING TRAIN AREA WILL BE CONNECTED TO ZP02 WITH MIMIC BACKUP PANEL

NOTE : BACKUP PANEL WITH COLOURED MIMIC, PB LAMPS, ANNUNCIATION WILL BE SUPPLIED BY BHEL EDN

								PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER			
								OBJECT					
								MODEL					
						TITLE							
						HMI CONFIGURATION FOR - FOHS (FOPH LCR)-COMMON FOR 5 UNITS			DCC	DRAWING ID/REV		SHEET	
						PROD. HMI System				EN-DG-1276-145-4001		02	10 (21)

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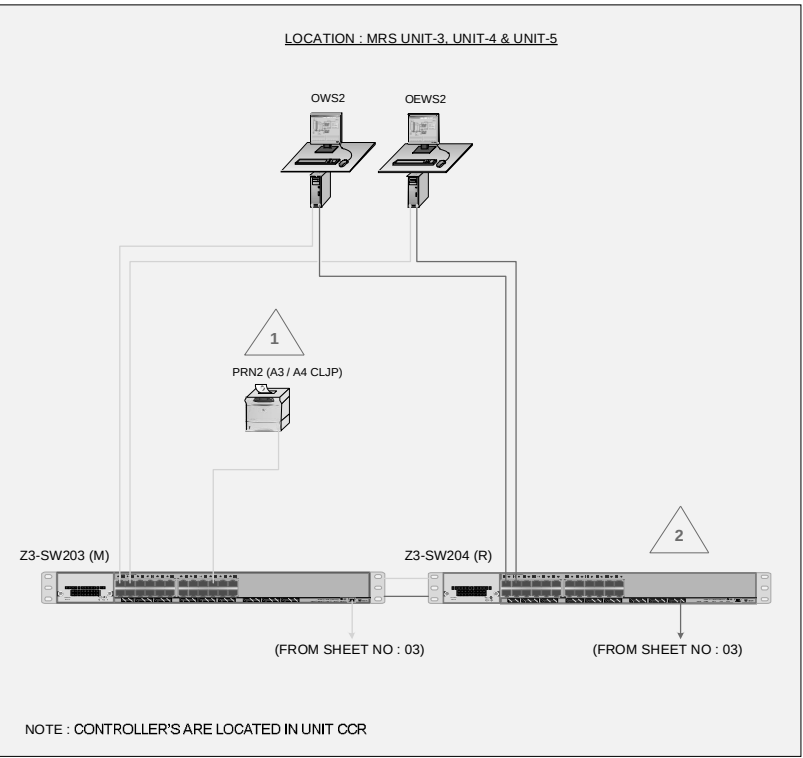
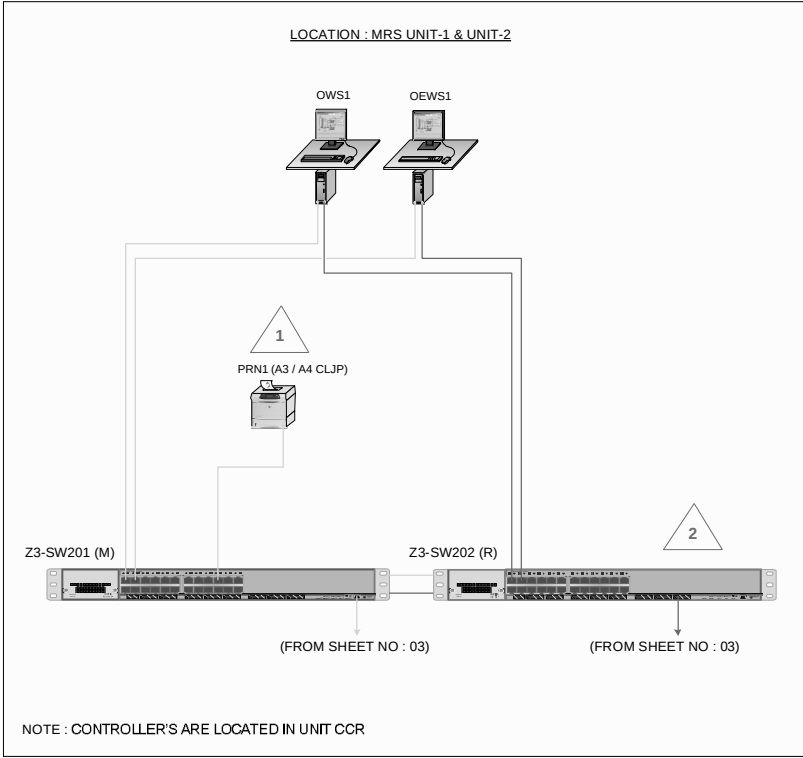
HMI CONFIGURATION FOR- COMMON REGEN ROOM (STAGE-I&II)



NOTE : UNITIZED DCS IS IN SERVICE VESSEL IN CCR

NOTE : BACKUP PANEL WITH COLOURED MIMIC, PB LAMPS, ANNUNCIATION WILL BE SUPPLIED BY BHEL EDN

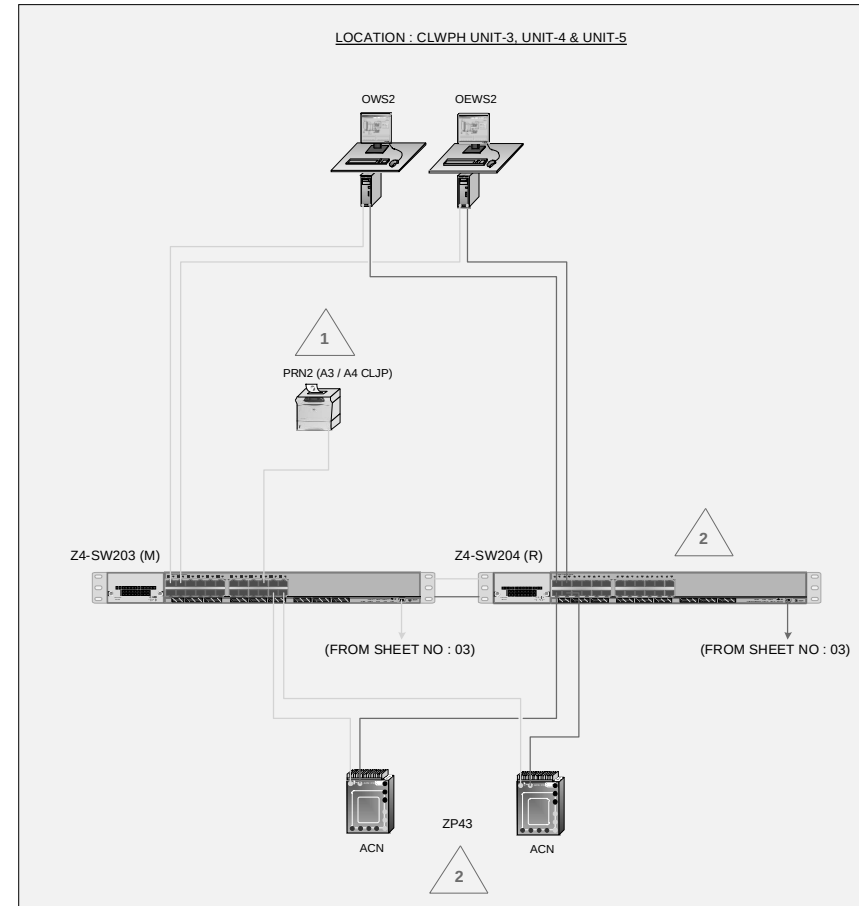
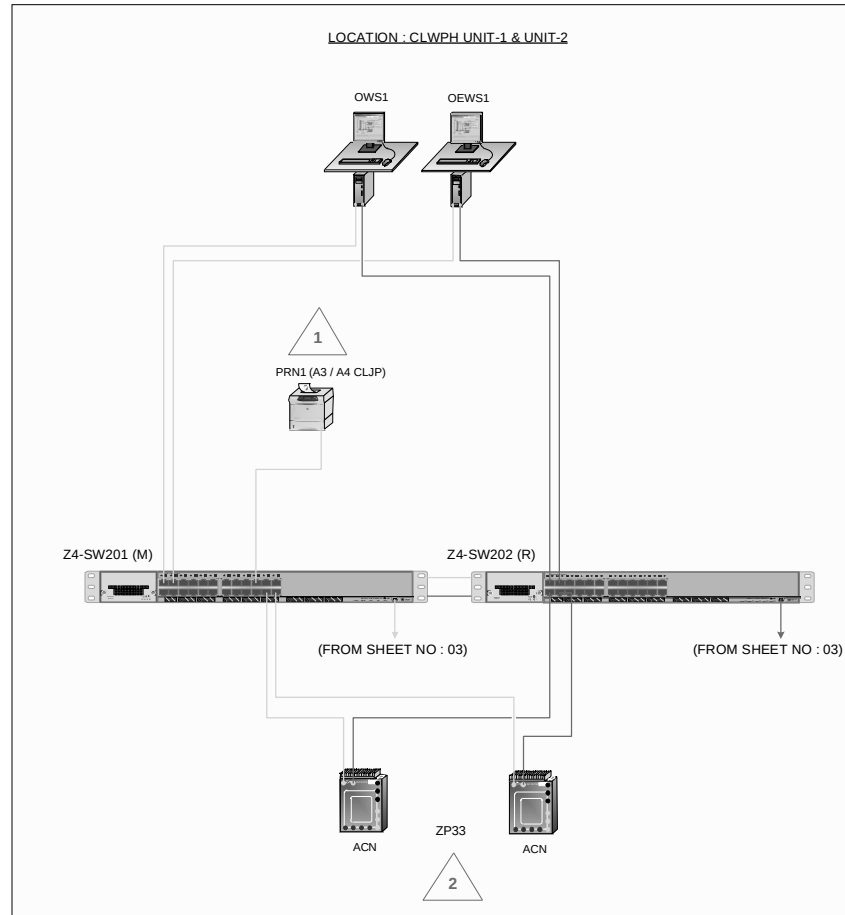
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												OBJECT									
												MODEL									
DATE		NAME		APPD		REVISION						REV.NBR		TITLE HMI CONFIGURATION FOR- COMMON REGEN ROOM (STAGE-II)							
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019											
FILE						APPLA						PROD.		HMI System		DCC		DRAWING ID/REV		SHEET	
																EN-DG-1276-145-4001		02		11 (21)	



1 STAGE WISE CONTROLLER WILL BE PROVIDED IN CCR

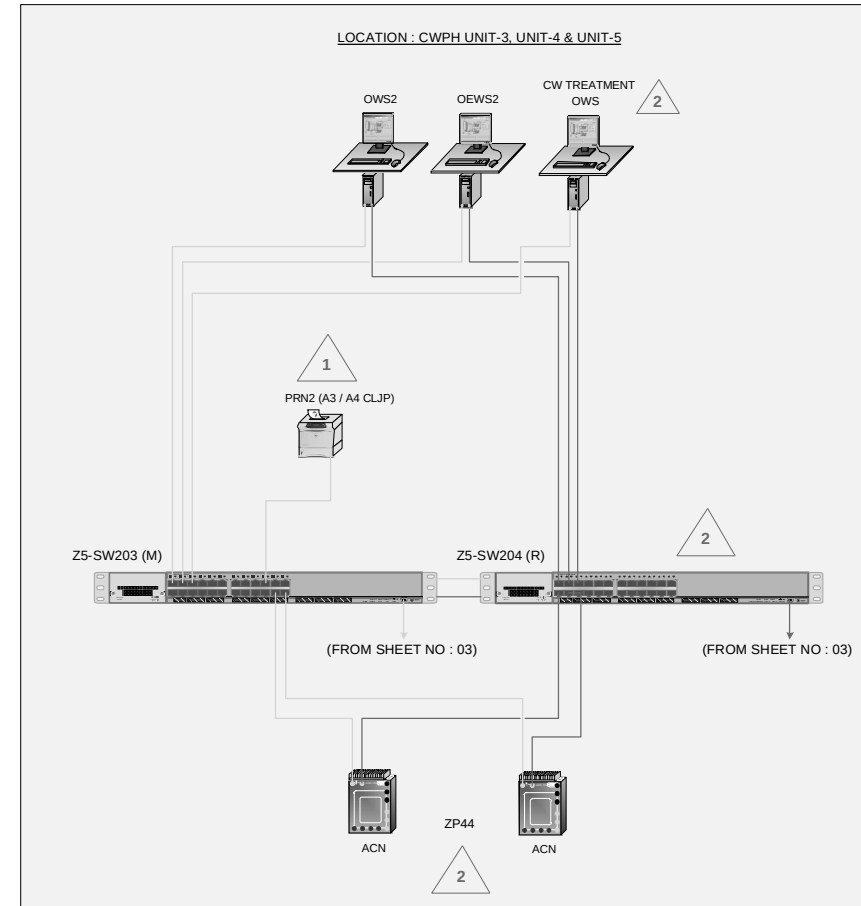
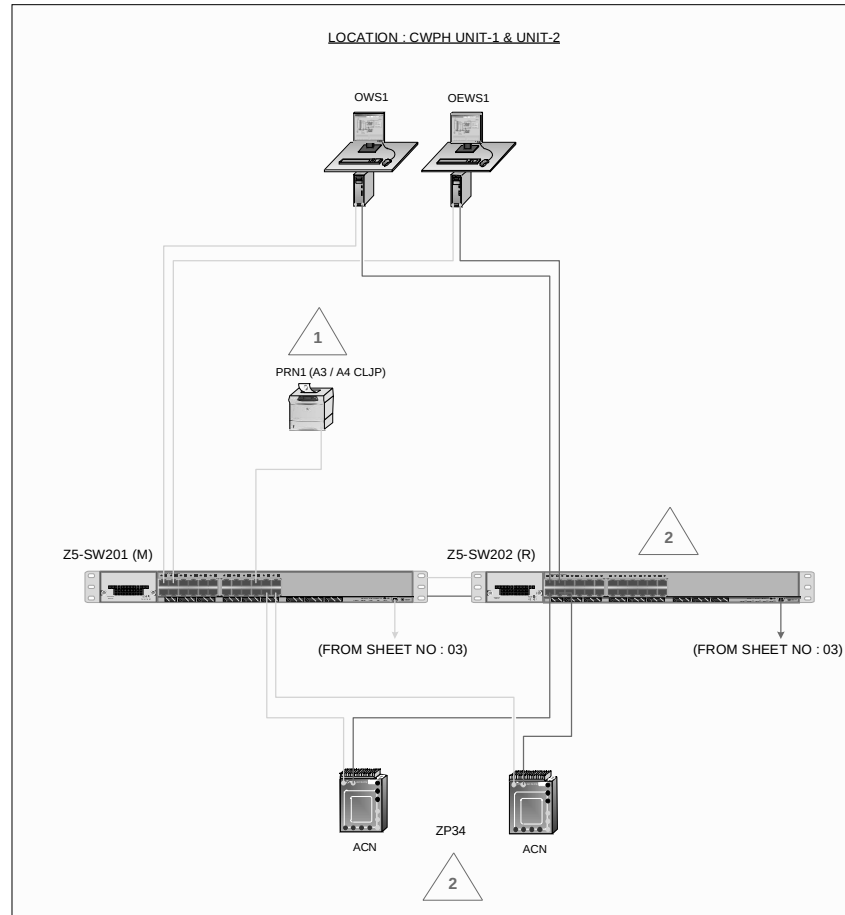
NOTE : BACKUP PANEL WITH COLOURED MIMIC, PB LAMPS, ANNUNCIATION WILL BE SUPPLIED BY BHEL EDN

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						OBJECT														
						MODEL														
DATE	NAME	APPD	REVISION			REV.NBR	HMI CONFIGURATION DIAGRAM (MRS)			DCC			DRAWING ID/REV			SHEET				
DESIGN. BHASKAR \ 01-03-2019		CHKD ABHISHEK \ 01-03-2019		APPD REETESH \ 01-03-2019		TITLE														
FILE				APPLA		PROD. HMI System														
									EN-DG-1276-145-4001			02		12 (21)						



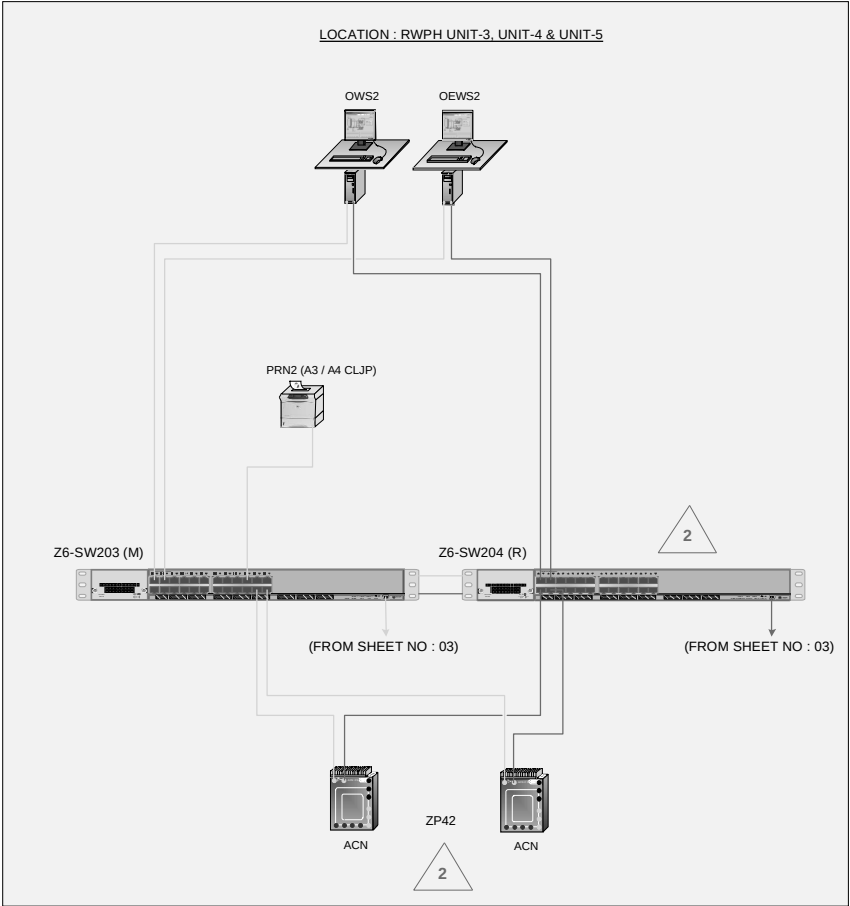
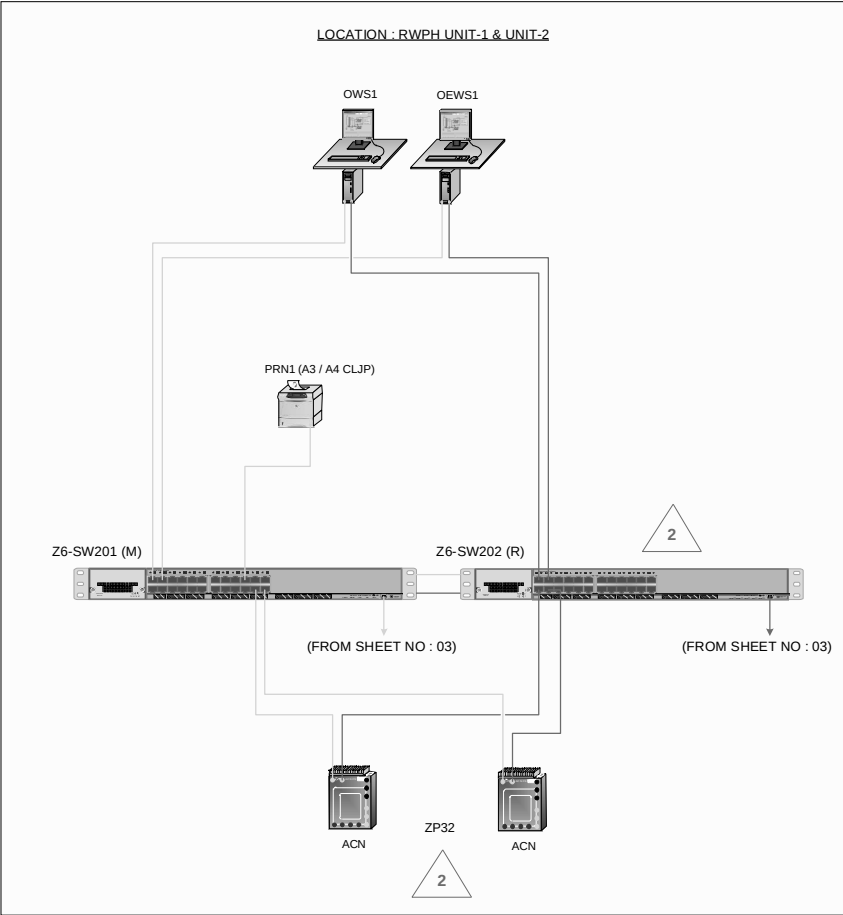
DESIGN.	BHASKAR \ 01-03-2019	CHKD	ABHISHEK \ 01-03-2019	APPD	REETESH \ 01-03-2019	REV.NBR	
FILE		APPLA					
DATE	NAME	APPD	REVISION	REV.NBR			
DESIGN.	BHASKAR \ 01-03-2019	CHKD	ABHISHEK \ 01-03-2019	APPD	REETESH \ 01-03-2019	REV.NBR	
FILE		APPLA					

Valmet	बी एच डी एल BH&L	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER
		OBJECT	
		MODEL	
TITLE	HMI CONFIGURATION FOR- CLWPH (LCR)	DCC	DRAWING ID/REV
PROD.	HMI System		EN-DG-1276-145-4001_02
			SHEET 13 (21)



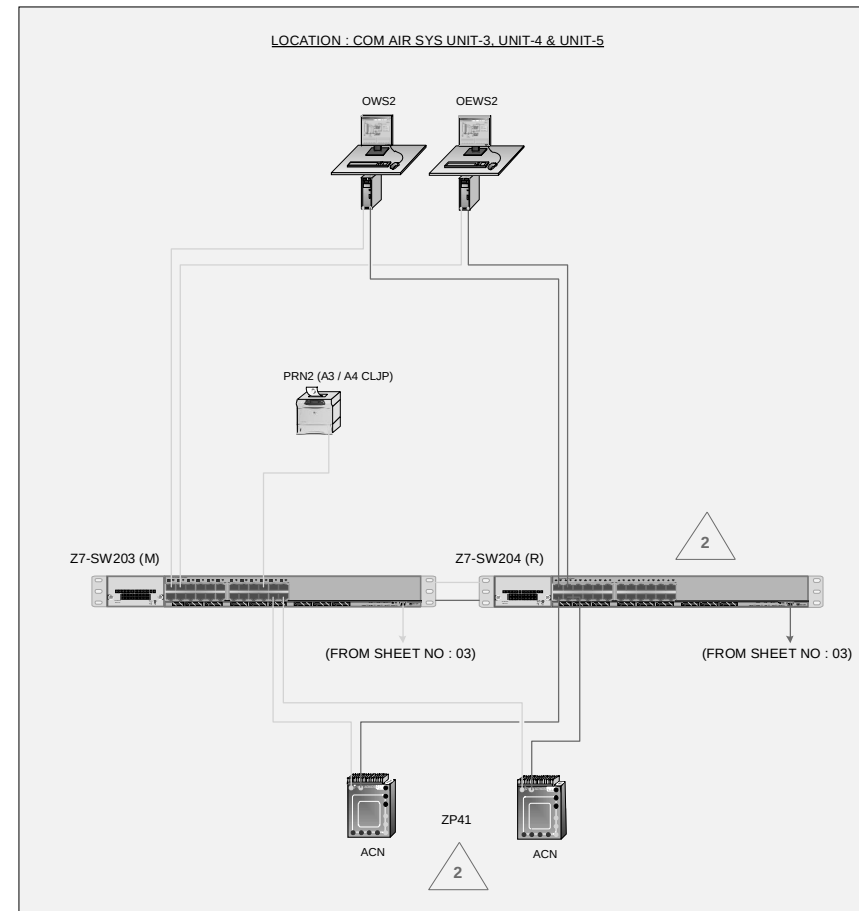
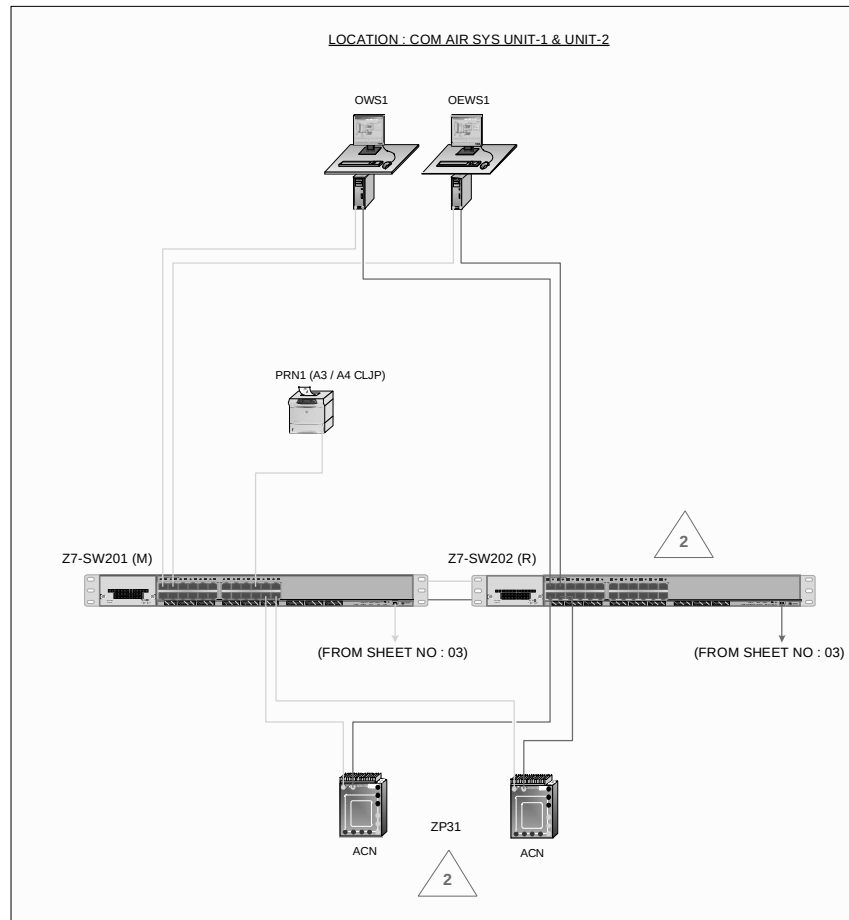
1 UNIT WISE RIO's WILL BE PROVIDED FOR CW / ACW

										PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER					
										OBJECT							
										MODEL							
DATE		NAME		APPD		REVISION				REV.NBR		TITLE HMI CONFIGURATION FOR-CWPH (LCR)					
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019							
FILE				APPLA				PROD.		HMI System		DCC		DRAWING ID/REV EN-DG-1276-145-4001		SHEET 02 14 (21)	



NOTE : BACKUP PANEL WITH COLOURED MIMIC, PB LAMPS, ANNUNCIATION WILL BE SUPPLIED BY BHEL EDN

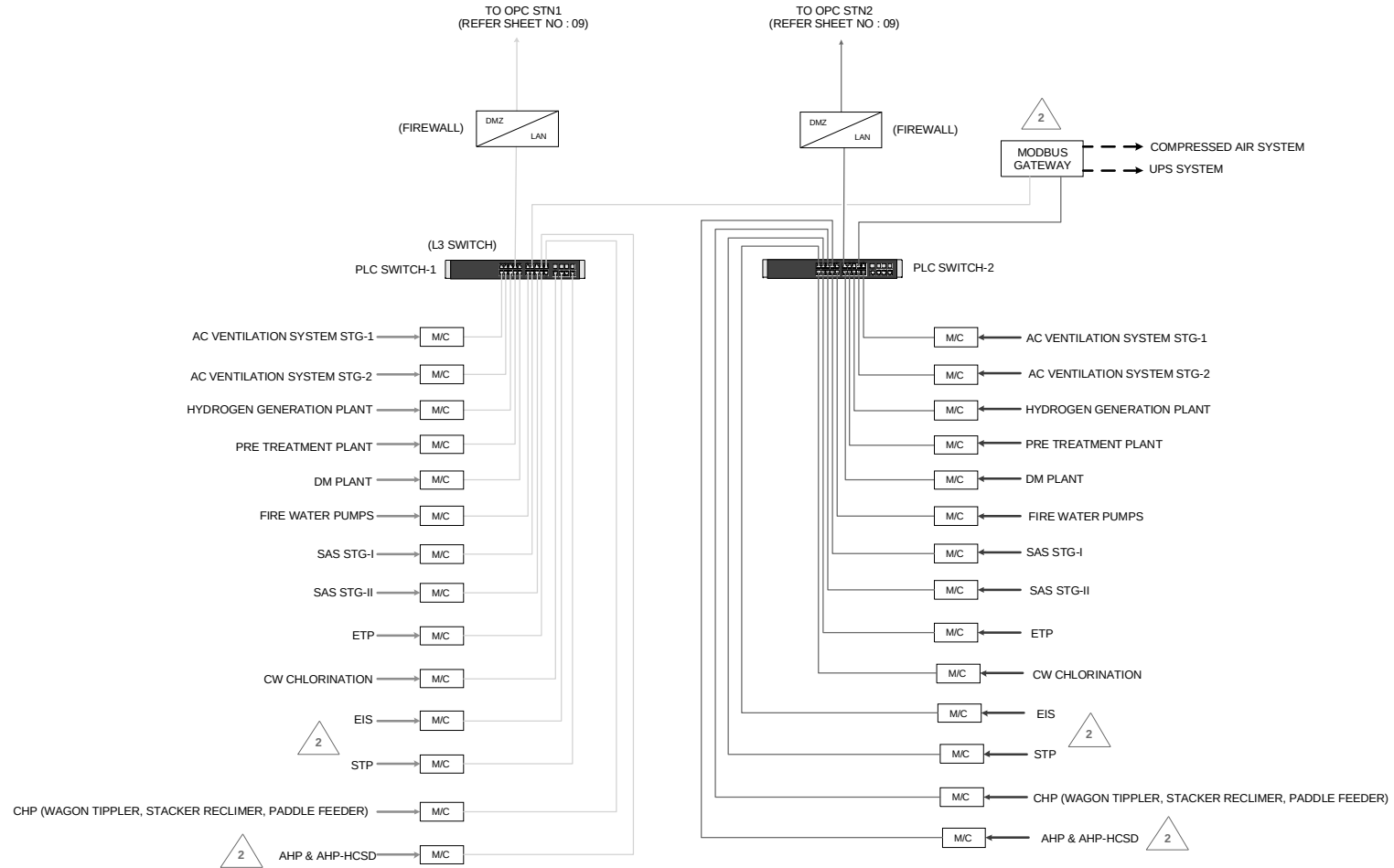
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							OBJECT								
							MODEL								
					TITLE										
					HMI CONFIGURATION FOR-RWPH (LCR)							DCC	DRAWING ID/REV		SHEET
					PROD. HMI System						EN-DG-1276-145-4001		02	15 (21)	
DATE		NAME	APPD	REVISION			REV.NBR								
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019					
FILE				APPLA											



NOTE : GUI AT COMPRESSED AIR SYSTEM CONTROL ROOM WILL BE SUPPLIED BY BOP VENDOR

				Valmet		बी एच ई एल		PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER	
						BHEL		OBJECT			
								MODEL			
DATE		NAME	APPD	REVISION				REV.NBR			
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019	
FILE				APPLA				PROD.		HMI System	
HMI CONFIGURATION FOR- COMPRESSED AIR SYSTEM (LCR)											
								DCC		DRAWING ID/REV	
										EN-DG-1276-145-4001	
										02	
										16 (21)	

HMI CONFIGURATION DIAGRAM (THIRD PARTY CONNECTIVITY DETAILS)



Note: Third party shall have OPC Client/server

NOTE: ALL ABOVE PLC CONNECTIONS WILL BE ON OPC PROTOCOL					Valmet बी एच ई एल BHEL		PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER								
						OBJECT											
DATE		NAME	APPD	REVISION			REV.NBR	TITLE									
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019		DCC		DRAWING ID/REV		SHEET	
FILE				APPLA				PROD.		HMI System				EN-DG-1276-145-4001		02	19 (21)

LEGEND :

- TWISTED PAIR CAT5 CABLE (TP) MAIN (100 Mbps)
- TWISTED PAIR CAT5 CABLE (TP) RESERVE (100 Mbps)
- OFC CABLE MAIN
- OFC CABLE RESERVE
- - - - - RS 485
- OWS : OPERATOR WORKSTATION
- OEWS : OPERATOR CUM ENGINEER WORKSTATION
- CLJP : COLOR LASER JET PRINTER
- ACN : APPLICATION & CONTROL NODE
- LVS : LARGE VIDEO SCREEN
- CIM I/O : BUFFERING STATION FOR INFO SERVER
- M/C : MEDIA CONVERTER

							PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER						
							OBJECT									
									MODEL							
DATE		NAME	APPD	REVISION		REV.NBR	TITLE HMI CONFIGURATION DIAGRAM (LEGENDS)				DCC		DRAWING ID/REV EN-DG-1276-145-4001		SHEET 02 21 (21)	
DESIGN.		BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019											
FILE					APPLA		PROD.		HMI System							

**VOLUME : VI
SECTION-VIII
LABORATORY INSTRUMENTS**

1.00.00 GENERAL

- 1.00.01 This section provides the technical information for the design, furnishing, construction and setup of an instrument shop/ Laboratory, complete with instruments, furniture, tools and test equipment required to maintain the instruments and control devices of the plant.
- 1.00.02 Testing instrument / devices offered shall be proven type and shall incorporate latest design. All instruments supplied under this package shall be in brand-new and unused condition.
- 1.00.03 The workmanship and design shall be proven and in accordance with the best engineering practice to meet the intended purpose. Bidder shall ensure satisfactory performance of testing instruments/devices even in the worst environmental condition. All instruments shall be supplied from reputed and proven manufacturer.
- 1.00.04 Testing instruments/devices shall be furnished with all necessary accessories and original instruction/operating and maintenance manuals.
- 1.00.05 The shop shall be provided with a complete set of test and calibration equipment/test kits for electronic and pneumatic instruments and controls, falling under the purview of this specification.
- 1.00.06 All instruments offered, shall conform to the relevant International Standards.
- 1.00.07 The various instruments/devices, small tools, accessories, etc. shall be furnished (in applicable cases) with suitable and durable crates, kits or carry boxes of convenient size; complete with necessary packing etc. for safe storage when not in use.
- 1.00.08 Measuring/testing instruments, along with associated accessories shall be suitable for intended operation (both indoor and outdoor installations as applicable).
- 1.00.09 Bidder shall be responsible for proper functioning of supplied items and shall make any necessary additions/modifications, as required for proper maintenance and testing of the installed instruments and controls. Bidder shall also be responsible for erection and commissioning of the test equipment.
- 1.00.10 It is obligatory to Bidder to furnish a complete list of spare parts for these testing/calibrating, instruments/devices. Bidder shall render guarantee for easy availability of all the spare parts required, especially for the components, which are prone to failure.
- 1.00.11 Bidder shall repair or replace the defective instruments/ devices at no extra cost within the guaranteed period of each instrument/device.
- 1.00.12 Bidder shall submit with the proposal a full list of testing/laboratory instruments / tools offered along with detailed specification of the items. Catalogues, drawings and manuals as required shall be submitted with the proposal to provide necessary information pertaining to the items offered. Proposed offer document shall include but not limited to the following:
- a) BOQ & Data Sheet

- b) Instrument laboratory room layout (tentative) along with room & equipment dimensions
 - c) Layout of test bench
 - d) Data/ information as per bid proposal sheet (Technical particulars)
 - e) Conformance to or deviation from the specification, if any.
- 1.00.13 Bidder shall furnish following drawings and documents after award of contract:
- a) Final version of all the drawing and document furnished along with bid
 - b) Drawing and document submission schedule
 - c) Load and utility list
 - d) Power supply, air and water distribution schemes
 - e) Mounting details including necessary accessories
 - f) Recommendations (if any) for installation/ storage etc
 - g) QAP
 - h) Inspection and Test report
 - i) Spare part list
 - j) Consumable list
 - k) Training details
 - l) O&M Manual
 - m) Any other scheme, data, drawing, document, etc required to establish product quality and completeness of supply.
- 1.00.14 Bidder to note that the testing and laboratory instruments specified in this section shall be in addition to the equipments required for installation, maintenance, trouble shooting and calibration of instrumentation and control equipments of the plant furnished under this volume of the specification. Also, any special simulator/test stands which may be recommended and supplied by Bidder for use in calibrating electronic components of the instrumentation and control systems shall be considered separately in addition to the laboratory instruments specified in this part. Bidder shall handover to Owner all equipment specified in this part immediately after receiving the equipment at the job site. Use of this equipment by Bidder shall not be permitted without Owner's consent.
- 1.00.15 Bidder shall include a complete set of furniture for the instrument laboratory from reputed manufacturer designed for similar applications. The set of furniture shall include but shall not be limited to chairs, tables for calibration of instruments, test benches etc, all necessary cabinets for storage of manuals / booklets / records / charts, storage racks for special tools etc. The design, color, layout and model of the furniture shall be approved by Owner.
- 1.00.16 The finalization of make & model of laboratory instrument solely lies with the Owner and same shall be finalized during detailed engineering.
- 1.00.17 Scope of service of the Bidder shall also include operational and service training of Owner's personnel at site.

- 1.00.18 Calibration and test certificates, as applicable, shall not be more than one (1) year old.

2.00.00 CODES AND STANDARDS

The design, material, construction features, manufacture, inspection and testing of laboratory instruments shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards.

3.00.00 DESIGN AND CONSTRUCTION REQUIREMENTS

3.01.00 DEAD WEIGHT TESTER - (2 NOS.)

- 3.01.01 Dual range dead weight tester shall be furnished to cover 0.1-16 Kg./Sq.cm. and -2-700 Kg/Sq.cm range. It shall be compact, stable, light in weight and self contained with anodized metallic base, steel weights, twin area screw pump with ball thrust and axially located hand wheel. Accuracy shall be 0.01% of the actual reading. Dead weight piston and cylinder shall have over pressure stops preventing the piston from coming out. These pistons shall be hardened stainless steel. Oil filter shall be furnished at fill-up point to prevent contamination. The tester shall have 1/2" NPT(F) connection. Adapters of different sizes to receive 1/4"BSP, 1/8"BSP, 3/4"BSP, 1/4" NPT, 1/8" NPT & 3/4" NPT etc pressure gauge shall be supplied. At least 3 no's of adaptor sets shall be supplied. The detailed adaptors required will be decided by the Owner. Make and model of dead weight tester shall be decided by the Owner from the list of dead weight testers furnished by bidder.

- 3.01.02 The following accessories shall be included :

- a) Angle connector for flush mounted gauges
- b) Spirit level
- c) Bag of seals
- d) Wrenches
- e) Spanners
- f) Pointer remover
- g) Pointer punch
- h) Can of fluid
- i) Dirt trap/ purifier

3.02.00 LABORATORY TEST PRESSURE GAUGES - (3 SETS OF EACH TYPE)

- 3.02.01 Three Sets of test pressure gauges (accuracy 0.1% including hysteresis) as listed below shall be supplied :

ITEM NO.	RANGE
01.	- 1 to 0 Kg/Sq.cm
02.	0 - 1.0 Kg/Sq.cm

ITEM NO.	RANGE
03.	0 - 1.6 Kg/Sq.cm
04.	0 - 2.5 Kg/Sq.cm
05.	0 - 4 Kg/Sq.cm
06.	0 - 6 Kg./Sq.cm
07.	0 - 10 Kg/Sq.cm
08.	0 - 16 Kg/Sq.cm
09.	0 - 25 Kg/Sq.cm
10.	0 - 40 Kg/Sq.cm
11.	0 - 60 Kg/Sq.cm
12.	0 - 100 Kg/Sq.cm
13.	0 - 160 Kg/Sq.cm
14.	0 - 250 Kg/Sq.cm
15.	0 - 400 Kg/Sq.cm
16.	0 - 600 Kg/Sq.cm

3.02.02 All test pressure gauges shall have 250 mm anti-parallax white dial with black figures and graduation lines of fineness and legibility used for high precision instruments. The dial shall be mirror-polished stainless steel under the tip of the pointer. Cases shall be fine wrinkle phenol or die cast aluminium, light but strong and rigid. Mounting shall be direct or flush.

3.02.03 The material of the sensing element shall be solid drawn phosphor bronze upto 10 Kg/Sq.cm and above 10 Kg/Sq.cm. stainless steel tube.

3.02.04 The pointer shall be lightweight, stainless steel balanced design with tip turned 90 degree for easy reading to smallest sub- division.

3.02.05 Connection size of all gauges shall be 1/2" NPT (M).

3.02.06 For all test gauges point-by-point test certificate of the readings shall be provided.

3.03.00 LABORATORY TYPE MANOMETER- (2 NOS OF EACH TYPE)

3.03.01 Enclosed type free-standing U-tube manometers of the following ranges shall be supplied :

ITEM NO.	RANGE
01.	0-250 mm of WC
02.	0-600 mm of WC (300-0-300)
03.	0-1000 mm of WC (500-0-500)
04.	0-2500 mm of WC (1250-0-1250)

05.	0-5000 mm of Hg
06.	0-8000 mm of Hg

3.03.02 These U type manometers shall be used for measuring low pressures, differential pressures or vacuum. Scales shall be calibrated in centimeters and sub-divided into tenths. These shall be suitable for maximum static pressure of 7 bar with an accuracy of $\pm 1\%$ of FSD. Cases shall be of aluminium on three sides with clear acrylic front cover. Scales shall have provision for zero adjustment.

3.03.03 All wetted parts and fittings shall be SS-304. Manometer will be mounted on M.S. three leg stand having level adjustment arrangement and attached spirit level. The scale graduations shall be engraved on milky white acrylic in black. Metering tube shall be clear acrylic plastic having uniform reamed bore and thick walls, gland-packed in end blocks. End connections shall be 1/2" NPT (F), with check valves. The scale shall be provided with vernier arrangement. Liquid drain plug shall be provided. 3 way & 5 way manifold, stand, coloured liquid & storing bottle, vernier, aspirator, check valve, liquid pump fill-up funnel and nylon tubes shall be included.

3.04.00 **INCLINED TUBE MANOMETER - (2 NOS.)**

3.04.01 Portable inclined tube manometers of free standing type of following ranges 0-50 mm, 0-100 mm and 0-200 mm WCL shall be provided.

ITEM NO.	RANGE
01.	0-50 mm of WC
02.	0-100 mm of WC
03.	0-200 mm of WC

3.04.02 These shall be used for measurement of draft, air velocity and air pressure around atmospheric pressure. The scale graduation shall be engraved on milky white acrylic in black and scale shall be calibrated in cm. Indicating tube and oil chambers shall be drilled and reamed in a solid block of clear acrylic plastic material. These manometers shall have levelling screws at the bottom and spirit level bubbles for accurate levelling. Each manometer shall be complete with connecting tubes, mounting box, brass range scale, tube chamber, connecting tube, 1/2" NPT process adapters, manometer liquid and drain plug. Five valve manifold shall be supplied along with each manometer.

3.04.03 Vertical type manometer with range 0-10mbar to 0-765mbar along with differential indicating liquid shall be provided. It shall have scale with black graduation on white background with zero adjustment facility. Accuracy shall be $\pm 0.25\%$ of reading.

3.04.04 Test manometer with range 0-10cm shall be provided. It shall have 0-200mm WC scale with zero adjustment facility. Accessories such as borosilicate glass tube in Al box, three & five way manifold, liquid pump aspirator, check valve, vernier etc shall be provided.

- 3.05.00 **PORTABLE MULTIFUNCTION CALIBRATOR – MICROPROCESSOR BASED - (3 NOS.)**
- 3.05.01 Portable Multifunction Calibrator shall be supplied for testing and calibration of process instruments. The calibrator shall have facility for measurement and simulation of the following instruments and parameters :-
- a) Pressure and DP transmitters
 - b) Electro-pneumatic converters.
 - c) Thermocouples and RTD
 - d) Electronic receivers and controllers
 - e) DC voltage & current generation
 - f) Frequency
- 3.05.02 The calibrator shall have large multiple digital indicator 4 to 5 digits. It can operate according to function and menu guided set up mode. The calibrator shall have storing facility of field calibration data together with set up information as per requirement.
- 3.05.03 The calibrator shall be microprocessor based with latest state of the art design and shall have LCD display simultaneously for both input and output signal, membrane type key pad with tactile sound, 230V AC mains supply, in built battery & battery charger, carrying case, test probes, fuse etc.. Preferred feature - IP-65 enclosure class.
- 3.06.00 **PRESSURE AND VACUUM AIR PUMP - (2 NOS.)**
- 3.06.01 Portable type Combined pressure and vacuum pump shall be supplied. This air pump is to produce pressure upto 2 bar for intermittent service, 1 bar for continuous service and to pull a vacuum as high as 700 mm of mercury. The actual free air delivery shall be 40 litre per minute at 1 bar.
- 3.06.02 This pump shall be complete with pressure gauges (150 mm dial pressure gauge 0-2.5 bar and 150 mm dial vacuum gauge 0-760 mm mercury), lubricator, moisture trap, dust filter, oil mist eliminator, solenoid operated isolation cum air admittance valve, hose nipples and other fittings & accessories.
- 3.07.00 **PRESSURE GAUGE COMPARATOR (2 NOS.)**
- 3.07.01 Pressure gauge comparator shall be supplied for testing pressure gauges and vacuum gauges upto 250 bar and 700 mmhg vacuum with an accuracy of +/- 0.2%. This unit shall be complete with test gauges of ranges 0-50 bar, 0-300 bar and 760 to 0 mm Hg. One slide wrench, screw driver, two gauge pointer removers, gauge adaptors set packed in a separate box, one lever handle union, gauge cock 1/2" NPT(F) and 1/4" NPT(F) connectors for pressure gauges to be tested and other accessories as required. The pressure developed by the test pump shall be continuously adjustable. Filling fluid, funnel to be supplied along with the unit. Comparator shall have the features of LCD digital display for pressure.
- 3.07.02 The comparator shall be of latest state of the art design and shall have in built battery and battery charger.

3.08.00 PRESSURE GAUGE COMPARATOR- PORTABLE TYPE (1 NO.)

3.08.01 Portable pressure gauge comparator shall be supplied for testing pressure gauges and vacuum gauges with in range of 8157 to 19999 mm WC with an accuracy of +/- 0.1% and 1 mmWC vacuum and pressure resolution. Pressure calibrator and comparator shall be supplied with one hand pump & digital calibrator cum indicator. It will be supplied with 4 1/2 digit LCD display, built in relief valve, zero adjustment facility etc.

3.08.02 The comparator shall be of latest state of the art design and shall have in built battery and battery charger.

3.09.00 DECADE RESISTANCE BOX - (2 NOS.)

3.09.01 Decade resistance box shall be supplied as per specification stated below :

3.09.02 A dial type resistance box shall be supplied. Range of resistance box shall typically be 0.01 ohm to 111.1111 K ohms. There shall be eight dials, each dial providing one decade of resistance value. The resistance coils should be made of manganin, non inductivity wound and aged resistors with low temperature coefficient and low contact resistance steps. The ends of the coils should be soldered to the terminal blocks with silver solder. The direct-reading accuracy of the resistance box shall be $\pm 2\%$ for 0.01 decade, $\pm 0.3\%$ for 0.1 decade, $\pm 0.05\%$ for 1,10,100,1K, 10K decades and $\pm 0.5\%$ for 100K decade . All resistors shall be temperature compensated.

3.09.03 Resistance box shall be supplied with probes, leads, clips, connectors etc.

3.10.00 A.C. UNIVERSAL BRIDGE- (1 NO.)

3.10.01 A.C. bridge of the following specification shall be supplied together with probes, leads, clips, connectors, power supply cord, accessories etc.

3.10.02 R.L.C. bridge shall have a measuring frequency of 1 KHz/10 KHz. The bridge shall be suitable for 240V, 50 Hz supply.

- Resistance : 10 Ohms to 10 M Ohms in seven full scale ranges with least count 10 m Ohms in 10 Ohms range.
- Capacitance : 1000 PF to 1000 micro F in seven full scale ranges with least count of 1 PF in 1000 PF range
- Inductance : 1000 micro H to 1000 H in seven full scale ranges with least count of 1 micro H in 1000 micro H range

3.10.03 It shall also be possible to measure "D" dissipation factor for capacitors and "Q" quality factor for inductances.

3.11.00 SIGNAL GENERATOR – (2 NOS.)

3.11.01 Signal generator shall have frequency range of 0.01 c/s to 200 K c/s in at least four ranges . The signal generator shall have sine wave, square wave and saw tooth wave outputs.

- 3.11.02 The output frequency shall be continuously adjustable and frequency reading shall be displayed on a digital indicator. The voltage range of the generator shall be switchable between 1V & 10V and continuously controlled and shall be monitored on a built-in digital voltmeter. The signal generator shall have high frequency stability and low harmonic distortion. Harmonic distortion shall be less than 0.5 percent. Signal generator shall be suitable for 240V single phase, 50 Hz, supply and shall be complete with carrying case, probes, fuse and other accessories as required.
- 3.12.00 **HAND TACHOMETER - (2 NOS.)**
- 3.12.01 Bidder shall supply combined contact and photo type tachometer with latest state of the art design.
- 3.12.02 The tachometer shall have a range of 10-99999 RPM for optical type and 10-25000 RPM for contact type and 6-1000 meters for linear reading. The device shall have integral non contact photo electric pickup with adapter for contact pickup. Non contact pick up shall have a range of 1-25 inches from target. It shall have 5 digit LCD display and shall be battery operated. The tachometer shall have data display time of 1 minute after release of measurement and data memory time of 30 minutes. The tachometer shall be rugged in construction and shall be complete with all accessories such as contact adapter, surface speed wheel, interchangeable tips-concave, convex, linear, reflective tape(100 strips), batteries, carrying case. A built-in safety clutch shall be incorporated to protect the tachometer against overload if the speed is higher than the selected range.
- 3.13.00 **INSULATION TESTER OF DIFFERENT RANGE - (1 NO.)**
- 3.13.01 Insulation tester shall be portable and battery operated type with LCD display. Test voltage shall be 250 V / 500 V / 1000 V / 2500 V D.C. Range of insulation measurement shall be from 0.5 Meg Ohms to 50,000M ohms with an accuracy of $\pm 5\%$. Insulation resistance shall be indicated on a meter.
- 3.13.02 Following accessories shall be included :
- a) Necessary carriers with rubber and steel centres
 - b) Measuring roller
 - c) Extension rod
 - d) Carrying case
- 3.13.03 The indication shall be magnetically damped. Push button shall be provided to hold the pointer for exact reading.
- 3.14.00 **D.C. REGULATED POWER SUPPLY - (4 NOS.)**
- Bidder shall supply D.C. Regulated Power supply designed with latest state of the art electronic and IC technology. D.C. Regulated Power supply shall have the following features :
- 01. Voltage Range : 0 to + 60V DC, 1 Amps. (floating), (Continuously adjustable)
 - 02. Voltage / Current Range : 0-60V/0-2.5A

meters

03. Display	:	LCD
04. Meter Accuracy	:	± 2% FSD
05. Power Supply Connection	:	240 V AC, 50 Hz.
06. Output Impedance	:	50 m Ohm or less.
07. Load Regulation	:	0.1% variation in voltage , 0.2% variation in current
08. Drift in 8 Hours	:	0.1% variation in voltage, 0.2% variation in current
09. Ripple and Noise	:	Less than 1 mV
10. Setting Resolution	:	20 mV / 20 mA
11. Temperature co-efficient	:	0.05% per Deg.C
12. Accessories	:	Test cords and clips as required.

Power supply shall be short circuit proof and crowbar protected.

3.15.00 **STOP WATCH – (2 NOS)**

3.15.01 **Digital Type**

Stop Watch shall be electronic type with LCD type display and complete with battery set and carrying case. The stopwatch shall have start, stop and reset button.

The case shall be non-rusting, dust and damp- proof.

3.15.02 **Mechanical Type**

Stop Watch shall be non- magnetic and with jeweled movement. The stopwatch shall have two hands, a large split second hand making one revolution in 30 seconds and having a dial sub divided into 1/10 seconds, the other hand will record on a small dial graduated to 15 minutes and in 1 minute interval.

The case shall be chromium plated, non-rusting, dust and damp proof. The face shall have white dial with steel hand and with bold figures.

3.16.00 **CONTINUITY TESTER -(10 NOS.)**

Continuity tester shall be electronic and battery operated. A hooter shall be provided which will sound when continuity detected. Tester shall be supplied with battery charger, lead wires and probes. The tester shall be kept in a carrying case.

3.17.00 TONG TESTER – (3 NOS.)

Tong tester shall be suitable for measuring the current ranges of 0-5/10-15/30 amps AC and DC. It shall have swiveling joint between tongs and meter to facilitate easy reading. Tong Testers shall have facility of indicating power factor, frequency and KW.

3.18.00 HIGH RANGE TONG TESTER – (1 NOS.)

High range tong tester shall be suitable for measuring the current ranges of 0-1000 amps AC with an accuracy of 1% and resistance of 0-2000 ohm with an accuracy of 1.2%. It shall have auto ranging facility along with 3 1/2 digit LCD display.

3.19.00 STABILISED POWER SUPPLY – (2 NOS.)

Bidder shall supply stabilized power supply designed with latest electronics and IC technology. It shall have the following minimum features:

01. Voltage Range : 0-240V AC, continuously adjustable.
02. Current Range : 0-10A
03. Power Supply Connection : 240V AC, 50 Hz
04. Indication : Meters indicating voltage and current shall be integral with power supply
05. Load Regulation : 0.25% variation in voltage
06. Accessories : Test lead wire

3.20.00 TEMPERATURE CONTROLLED BATH - (1 NO.)

Electronically controlled Temperature bath of following specification shall be supplied. Range approximately (-20) to (+100) Deg.C

- a) Insulated box of capacity (water / freezing liquid) around 0.02 Cu.m.
- b) Provision of holes with lids on the top for inserting thermocouples / RTD / Temperature gauge. The temperature controller shall have LED / LCD type display for set and measuring parameter. Operating voltage shall be 240V, 50Hz, 1 Ph.
- c) Unit shall be complete with Thermo element, Power supply cords, etc.

3.21.00 TEMPERATURE CALIBRATOR – (3 NOS.)

Electronic type comprising of integral electric heater, thermometer, temperature indicating controller and cooling fan with stability within ± 0.2 Deg C. Instrument shall have range of 0-600 Deg C. The equipment shall be complete with all standard and required accessories and carrying case. Instrument shall have provision for accommodating different bulb size thermometers/temperature elements (Thermocouples/RTD).

3.22.00 TEMPERATURE CALIBRATOR – TABLE MOUNTED (2 NOS.)

Microprocessor based temperature calibrator programmable for different temperature and slope rates suitable for RTD, thermocouple, switches shall be supplied. It shall have self diagnostic capability along with low battery indication and 4 ½ digit LCD display. It shall have following ranges:

- a. Range of -50 to 123°C along with accuracy of $\pm 0.3^{\circ}\text{C}$, resolution of 0.1°C , and stability of $\pm 0.05^{\circ}\text{C}$.
- b. Range of 50 to 600°C along with accuracy of $\pm 0.5^{\circ}\text{C}$, resolution of 0.1°C , and stability of $\pm 0.05^{\circ}\text{C}$.
- c. Range of 200 to 1204°C along with accuracy of $\pm 2^{\circ}\text{C}$, resolution of 1°C , and stability of $\pm 0.5^{\circ}\text{C}$.

The accessories shall include calibration software, RS-232C interface etc.

3.23.00 HOT AIR BLOWER – (1 NO.)

Portable hot air blower of reputed Make shall be supplied. Blower shall be suitable for 240V A.C., 50 Hz supply.

3.24.00 STROBOSCOPE –(1 NO.)

Portable stroboscope suitable for 240V AC, 50 Hz, supply from reputed Make shall be supplied. Measuring range shall be from 0 to 6000 rpm minimum in suitable ranges. It shall have flash rate of 100 to 10,000 flashes/ minute with Xenon flash lamp.

3.25.00 PORTABLE TREND RECORDER - (1 NO.)

Recorder shall be suitable for 240V AC, 50 Hz, supply. Recorder shall have signal-conditioning circuits to receive 4-20 mA, DC, thermocouple, RTD and other voltage-current signals encountered in electronic circuits. Recorder chart shall have 6 speed selections between 2 and 700 cm per hour. the recorder shall be 3-pen type. The scales shall be graduated in 0-100%. Accuracy shall be $\pm 1\%$ or better. Reference junction compensation feature shall be built-in. The minimum input impedance for voltage measurement shall be 500 K Ohms and for current inputs the impedance shall be 950 Ohms. The following spares and consumables shall be provided:

- a) Chart rolls
- b) Ink cartridges/sacks
- c) Replacement tips
- d) Chart drive motor

3.26.00 BAROMETER – (1 NO.)

Precision barometer shall be electronic type (digital display) with a range of 660 to 800 mm Hg with 0.1 mm Hg accuracy complete with battery, battery charger

and carrying case. The display shall be barometric pressure, humidity and temperature.

3.27.00 SURFACE PYROMETER– (2 NOS.)

3.27.01 Bidder shall supply pyrometer with spectral response 8 to 14. Instrument shall be supplied with hand held probe and cable (5 metres) assembly. Indication shall be by 5.1/2 digit LED display. Range shall be 0-999 Degree Celsius. Accuracy shall be $\pm 0.8\%$ and repeatability shall be 1°C . Analog output shall be 0-1V or 1 Mv/ $^{\circ}\text{C}$. It shall have RS 232C interface facility.

3.27.02 Instrument shall have internal chargeable battery. Battery charging circuit suitable for 240V AC, 50 Hz shall be integral with the instrument.

3.28.00 ELECTRONIC AND PNEUMATIC TEST BENCH - (2 NOS.)

3.28.01 Self contained test bench with sets of drawers for testing and repair of electronic/ electrical / pneumatic instruments and gadgets shall be supplied. This shall include necessary isolating switch, power supply switch, holding brackets, power supply sockets, signal sockets, meters, plugs, variac, air gun etc. laid aesthetically in a bench-top unit. Computer aided calibration facility with calibration management system shall also be provided.

3.28.02 Combined panel & desk type arrangement with instruments/ hardwares laid aesthetically shall be provided. Front and slant area shall be of 3mm CRCA sheet. Other sides including door shall be of 2mm CRCA sheets. Suitable illumination with door operated switch shall be provided. Color shall be Brilliant White (interior) and Light Grey 631 shade IS 5 (EXTERIOR). However, approval of color shade shall be obtained from Owner during detailed engineering.

3.28.03 Electronic part of the test bench shall include but not limited to, all the required test instruments and accessories such as power supply sockets with switch (415V AC-15/5A - 2 Nos, 230V AC -15/5A - 4 Nos, 220V DC - 2 Nos, $\pm 24\text{V DC}$ - 2 Nos, $\pm 48\text{V DC}$ -2 Nos, $\pm 12\text{V DC}$ -2 Nos, $\pm 5\text{V DC}$ -2 Nos). Voltage levels are tentative and shall be matched to supply requirements of Bidder and Owner's range of products. Other instruments/ hardware shall include Digital Oscilloscope, Decade Resistance Box, Digital Multimeter, Function Generator, Chartless Recorder, Variable DC Stabilised power supply, Variable AC power supply, Stepdown transformer, Continuity Tester, Fixed power supply, Electrically operated Air gun, MCB for each instrument, Digital LCR-Q Bridge, Card IC Tester, Soldering and Desoldering station, Power Meter with Harmonic Analysis, Tool Box with screw driver set, spanner, plie cutter etc.

3.28.04 Temperature Bath of the test bench shall consist of medium (600°C) and high (1200°C) temperature baths for calibration of thermocouples and RTD, Scanner/ thermometer with digital display and with RS232C interface, temperature calibrator etc.

3.28.05 Pneumatic part of test bench shall include, but not limited to, all the required test instruments and accessories such as power supply sockets with switches, Pressure and Vacuum gauges, Low/ medium/ differential pressure manometer/ calibrator and controller, Multifunction calibrator station, High pressure calibrator, Variac, Motorised vacuum pump, Portable high pressure pump, Dead weight tester, Portable multifunction calibrator, Air filter regulator, Electrically operated Air gun, MCB for each instrument etc.

- 3.28.06 Computerised calibration system shall consist of server and PC, 21" TFT monitor and A3 color laser jet printer and shall be located on the test bench (Details of the system shown in latter part of specification).
- 3.28.07 The variable A.C supply shall have a range of 0-240V and sub-panel shall contain ammeter and voltmeter. The output shall be protected with circuit breaker. A voltmeter shall be provided in sub-panel to indicate input and output voltages.
- 3.28.08 D.C. supplies shall be externally settable, floating type, reverse polarity protected. A metering sub-panel shall be provided for monitoring voltage, current with necessary plug sockets.
- 3.28.09 Standard utility outlet sockets (4 nos.) shall be provided. A compressed air blowing arrangements shall be included having a gauge, regulator and flexible hose.

3.29.00 PORTABLE DIGITAL MULTIMETER - (10 NOS.)

01. Display : 5 1/2 digit LCD display with unit indication
02. Functions : DC volts, AC volts, DC Ma & A, AC Ma & A, Ohms
03. Range : DC Volts; AC Volts; DC mA, AC mA, frequency and Ohms (Total 25 ranges)
- a. DC Voltage-0- 200 mV / 1000 V
- b. AC Voltage-0- 200 mV / 750 V
- c. DC Current-0- 200 mA / 2A
- d. AC Current-0- 200 mA / 2A
- e. Resistance-0- 200 Ohm/ 200 M Ohm
- f. Frequency-10 Hz to 100 kHz
04. Accuracy : $\pm 0.25\%$ of reading+1 digit basic range
05. Range selection : Manual and automatic with over range indication
06. Zero adjustment : Automatic
07. Overload protection : Up to 1000V DC or AC
08. Polarity indication : Automatic
09. Power supply : Battery/ mains operated with low battery voltage indication
10. Accessories : Test lead, fuse , battery

3.30.00 PORTABLE VACUUM TESTER (2 NOS.)

- 3.30.01 It shall calibrate and test vacuum instrument ranges 760 mm Hg vacuum and comprise of precision test gauge with swivel fitting shut off valve, pistol grip

handle, etc. It should be light weight for field use and should have Needle valve for positive shut-off piston grip, handle for quick, easy pump action.

3.30.02 It shall have the following features and specification:

- 01. Carrying Case : High impact plastic with a die cut foam insert snap open enclosures and handle fitted slots for the tester and two spare gauges.
- 02. Accuracy : $\pm 0.5\%$ of gauge span
- 03. Range : 0 to 760 mm Hg
- 04. Test Connection : 1/2" NPT 60 cm long nose

3.31.00 FIELD TRANSMITTER CALIBRATOR - (2 NOS.)

3.31.01 Bidder shall supply portable Field Transmitter Calibrators suitable for configuration and calibration of smart transmitters.

3.31.02 Field Transmitter Calibrators shall have following features:

- 01. Type : Portable
- 02. Display : 4 1/2 digit LCD
- 03. Range : 4-20Ma DC
- 04. Unit : Ma or percent
- 05. Output simulation : 24V DC loop power
- 06. Over range protection : 25%
- 07. Adjustment : Continuous output
- 08. Battery power supply : Rechargeable power pack
- 09. Accuracy : 0.1%
- 10. Accessories : Battery holder, carrying case, fuse, test leads, battery charger unit along with rechargeable battery

3.32.00 FIELD PRESSURE COMPARATOR(PORTABLE) – (4 NOS.)

- 01 Features : Single volume pump with integral pressure regulator for fine pressure adjustment
- 02 .
- 03 Accuracy : $\pm 0.5\%$ of gauge span.

- 04 Range : 8157 to 19999 mmwcl , with 1 mmwcl vacuum and pressure
- 05 Display : 4 ½ digit calibrator LCD readout
- 06 Adjustment : zero adjustment.
- 07 Accessories: Pressure calibrator/ pressure comparator shall be supplied with one hand pump,digital calibrator cum indicator , built in relief valve , Four test gauges. Gauge shall be compensated for temperature; operating pressure 300 Kg/Sq.cm maximum

3.33.00 PORTABLE GAS ANALYZER – (1 NO. CO & CO₂ , 1 NO. O₂, 1 NO.NO & NO₂, 1 NO. SO₂)

Bidder shall supply one (1) no. manually operated portable flue gas analyzer with an accuracy of $\pm 2\%$ for field determination of content of following gases in flue gas:

CO:0-1000 PPM

O₂ : 0-25% by volume

NO:0-100 ppm

SO₂ : 0-1000 ppm

HC:0-100% LEL

Power supply shall be 230V AC. It shall have RS232C interface facility. All hardware items such as battery, battery charger, filter, probe, leather case, cable etc. and chemicals required for operation of these analyzers shall be furnished.

3.34.00 SOLDERING IRON WITH SOLDER SUCKER (8 SETS)

3.34.01 Soldering iron shall be provided along with temperature controlling equipment for precise adjustment of temperature. Different sizes of soldering tips shall be provided with the iron.

3.34.02 Solder sucker shall be provided for removal of molten solder from terminal connections.

3.35.00 DESOLDERING STATION (1 SET)

- 3.35.01 Soldering iron shall be provided along with temperature controlling equipment for precise adjustment of temperature. Different sizes of soldering tips shall be provided with the iron.
- 3.35.02 Accessories shall include desoldering handpiece, power cord, connecting cable, iron holder, handle, cleaning drill, nozzle remover, heat resistant pad etc.
- 3.36.00 **VARIAC – (1 NOS.)**
- Light weight variac providing voltage upto 550V, 10A, 50 Hz is envisaged. Voltage scale around the voltage-varying knob shall have white lettering and graduation as black back ground.
- 3.37.00 **POWER PACK – (2 NOS.)**
- 3.37.01 Bidder shall supply power pack designed with latest state of the art electronics technology. It shall accept 110V 1 phase / 240V 1 phase, 50 Hz signal as input. Output voltage of the power supply pack shall be 0-60V adjustable over the entire range. The systems shall be capable of providing both positive and negative supply voltage with respect to a common reference point.
- 3.37.02 Power supply packs shall include indicating meters to indicate the output voltage and output current. The power pack shall be capable of delivering current upto 10 Amps. Max ripple should be 5 mA at full load.
- 3.38.00 **VIBRATION ANALYZER BALANCER INSTRUMENT - (2 NOS.)**
- 3.38.01 The microprocessor based portable self-contained dual input instrument shall have the following specification and features :
- 01. Indication : Digital/Analog frequency and amplitude meter
 - 02. Frequency : 60 to 6,00,000 CPM
 - 03. Sensitivity : 0.03 microns peak to peak adjustment
 - 04. Diagnostic : Hard copy tabular print-out
 - 05. Printer : In-built; Amplitude and frequency plotting capability (3 speeds)
- 3.38.02 The instrument shall have two range manual tunable filter, two range internal oscillator, high density stroboscopic light (One flash per cycle up to 15000 cpm, sub multiple firing up to 600000 cpm). The instrument shall be capable of the following measurements:
- a) Displacement in 0 to 3000 micron in 8 ranges.
 - b) Velocity in 0-3000 mm / sec. in 8 ranges.
 - c) Acceleration in 0-100 g in 8 ranges.
 - d) Spike energy 0-100 g's in 8 ranges.

3.38.03 The instrument shall have LCD backlit display, membrane type key pad , replaceable, seales, rechargeable battery and battery charger. Enclosure class shall be IP-65.

- a) Temperature Range : 0 to + 50 Deg.C
- b) Power Supply : 230V, 50 Hz, 1 Ph, AC

3.38.04 Accessories.

- a) Accelerometer
- b) Straight probe
- c) Pick up cable
- d) Stroboscopic light
- e) Strobe cable
- f) Fuse
- g) Power cable

3.39.00 **FURNACE (1 NO.)**

Furnace shall be suitable for 240V, Phase, 50 Hz power supply, capacity of heating chamber shall be 0.25 cubic metres and it should be insulated with glass wool and heated by high grade wire elements distributed along the bottom and sides, giving a uniform temperature. Furnace temperature shall be indicated by a thermometer and controlled by a thermostat over a range of 0-1100 Deg.Celsius. ON/OFF positions of thermostat shall be indicated by an indicating lamp. On/ Off switch along with indication lamp shall be provided.

3.40.00 **PORTABLE METER CALIBRATOR (2 NOS.)**

3.40.01 This instrument shall provide an accurate measure of DC, AC, Volts, amps and ohms. It shall be able to generate milliamperes for instrument calibration. It shall be electronic type with LCD display and shall be provided with battery and battery charger.

3.40.02 Battery charging circuit shall be integral with the instrument and shall be suitable for 240V, AC, 50 Hz supply.

Ranges :

- D.C. Volts : 0 - 1mV - 10V
- D.C. Current : 0 - 1 micro A-1A
- A.C. Volts : 0 - 1mV - 10V
- A.C. Current : 0 - 1 micro A - 1A
- Ohms : 1 Ohm - 10 M Ohms
- Accuracy : $\pm 0.1\%$

3.41.00 **DIGITAL CABLE IDENTIFICATION SYSTEM (1 NO.)**

Features : Quick identification of shorting lines and open lines.
It shall handle upto 96 pairs at one time.

3.42.00 DUAL BEAM PORTABLE DIGITAL STORAGE OSCILLOSCOPE (2 NOS.)

01. Bandwidth (3 db)	:	60 MHz
02. Selection	:	Trigger, Time base, Horizontal & Vertical deflection
03. Deflection factor	:	2 mV/div. to 5 V/div.
04. No. of Steps (Vert.)	:	10 (min) (1-2-5)
05. Accuracy	:	± 0.5% or better
06. Input impedance (Signal)	:	1 M Ohm, 20 pf
07. Maximum voltage	:	400V d.c./a.c. p to p
08. CMRR	:	10:1 at 50 MHz (minimum)
09. Sample rate	:	10 x 10 ⁶ /Sec.
10. Record memory	:	4K points
11. Save memory	:	4K points
12. Display mode	:	x1, x10, storage compress
13. Time base	:	0.05 s/div. to 0.5 s/div.
14. No. of steps (hr.)	:	20 (min) (1-2-5)
15. Input impedance (trigger)	:	20 K Ohm
16. Time base linearity	:	± 5%
17. Z modulation frequency	:	Upto 5 MHz
18. Controls available	:	Intensity, focus, brightness
19. Operating voltage	:	100-250V AC, 50 Hz
20. Ambient temperature	:	0-50 Deg.C
21. Feature	:	Overload protection
22. Accessories	:	Probes, carry case etc., as required

3.43.00 HAND HELD THERMOCOUPLE AND PT-100 OHM SIMULATOR AND INDICATOR (1 NO.)

3.43.01 Bidder shall supply hand held type T/C and RTD Pt-100 simulator and indicator. The instrument shall be electronic type with in built battery and battery charger.

3.43.02 It shall have following specification:

01.	Indication	:	Liquid Crystal Display (LCD)
02.	Operating Temperature Limits	:	- 20 to 55 Deg.C
03.	Storage Temperature Limits	:	- 30 to 60 Deg.C
04.	Temperature Resolution	:	1.0 or 0.1 Degree
05.	Function	:	Generation/ measurement of Thermocouple e.m.f (for K,E,J,T,N,B,R,S) Generation / measurement of equivalent RTD Temperature (PT-100)
06.	Accessories	:	Test lead, carrying case, battery & battery holder, fuse, battery charger along with rechargeable battery

3.44.00 SUPPRESSED RANGE MERCURY IN GLASS THERMOMETER (2 SET)

Bidder shall supply suppressed range Mercury in glass thermometers for temperature baths / calibrator consists of the following gauges :

01.	0 – 52 deg. C	:	1 No.
02.	48 – 102 deg. C	:	1 No.
03.	97 – 152 deg. C	:	1 No.
04.	147 – 202 deg. C	:	1 No.
05.	197 – 252 deg. C	:	1 No.
06.	247 – 302 deg. C	:	1 No.
07.	297 – 360 deg. C	:	1 No.
08.	350 – 402 deg. C	:	1 No.
09.	395 – 605 deg. C	:	1 No.

3.45.00 I.C. INSERTION AND EXTRACTION TOOLS FOR VARIOUS PIN NUMBERS 14,16 AND 48 (2 NOS.)

Bidder shall supply the tool having professional quality and of reputed make.

3.46.00 RHEOSTATS (1 SET.)

Rheostat shall be slide resistor type wound on ceramic frame. It should have max temperature rise of 375°C and maximum working voltage of 500 volts. Bidder shall supply Rheostats of the following ratings from reputed manufacturer:

01. 1A	:	1 No.
02. 2A	:	1 No.
03. 5A	:	2 No.
04. 10A	:	2 No.
05. 12A	:	1 No.
06. 18A	:	1 No.

3.47.00 DESKTOP DIGITAL MULTIMETER - (2 NOS.)

Bidder shall supply desktop type Digital Multimeter for measuring DC and AC voltages, currents and resistances. Desk top type Digital Multimeters shall have the following features:

01. Display	:	5 – ½ digit LED display
02. Measurements	:	DCV, ACV, Resistance (2W, 4W), DCA, ACA
03. Maximum Measurements in standard ranges	:	DCV - 1000V ACV - 700V Resistance - 200 Mohm DCA - 2A ACA - 2A
04. Sampling rate	:	Selectable
05. Over range information	:	To be displayed
06. Data Memory	:	To store upto 2000 measured data and atleast 10 set up information
07. Operating Temperature	:	5 – 40 deg C
08. Power Requirements	:	240V AC, 50 Hz
09. Communication Interface	:	RS-232C
10. Special functions	:	Auto range mode, Auto sample mode
11. Accessories	:	Power supply cord, Measurement lead, Remote connector

3.48.00 PHASE SEQUENCE METER - (1 NO)

Electronic type

3.49.00 **FREQUENCY METER – (1NO.)**

Electronic type

3.50.00 **MINISCOPE METER – (1NO.)**

BW: 100Mhz, Sampling rate: 5 Gs/s, No. of channel: 2 + ext. trigger, Rise time: 3.5 ns, Time/divn.: 5ns-60s, Vol / div. 1mv to 100v, Record length: 512 Bytes / 30000 Bytes, Screen wave form / set up memory:- 10,20,40, Ni-cd operation and charger for minimum 4 hour operation, Automatic set up and trend plot

Accessories: Charger set, Probe set and Carrying case etc.

3.51.00 **VIBRATION / SOUND LEVEL MONITOR – (1NO.)**

01.	Velocity Range	:	0 – 3000 mm/sec
02.	Vibration Measurement	:	0-3000 micron peak to peak
03.	Sound amplitude measurement	:	45-140dB
04.	Frequency Range	:	10-10000 Hz
05.	Accessories	:	Microphone, vibration pick up, straight probe, pick up cable, carrying case, battery & battery charger

3.52.00 **TOOL KIT BOX– (12NOS.)**

Each box shall comprise of sets of Allen keys of different sizes both in inch and millimeter, slide wrenches of different sizes, D spanner of different sizes, electric tester, Ring spanner of different sizes, Insulated screw drivers etc. as a minimum.

3.53.00 **WORK BENCH – (2 NOS.)**

Heavy-duty wooden construction with drawers, racks, vice, drill machine.

3.54.00 **INSTRUMENT RACK – (2 NOS.)**

Heavy-duty steel rack for storing bulk quantity of transmitters, switches, RTD, thermocouples etc during any capital maintenance of machine.

3.55.00 **PORTABLE PH CALIBRATOR – (2 NOS.)**

To check and calibrate pH measuring equipments. Compact portable simulator shall be offered.

01.	Range	:	0 – 14 pH in steps of 1 pH
02.	Accuracy	:	±0.01 pH

03.	Electrodes	:	Combination or Glss & Reference
04.	Display	:	4 digit LCD
05.	Stability	:	0.1 Ph / 24 hrs at constant temperature
06.	Temperature compensation	:	0-100 °C, manual/ automatic
07.	Power source	:	240V, 1 Ph, 50Hz
08.	Accessories	:	Battery pack with charger, digital display, connector leads, carrying case, buffer tablets, test & glass electrode and others as necessary.

3.56.00 OIL CONDITION MONITOR– (1 NO.)

01.	Type	:	Portable Particle Counter
02.	Quantity	:	One (01)
03.	Power supply	:	240V AC mains and Battery operated
04.	Indication	:	Front panel scrollable data
05.	Function Key	:	Membrane key
06.	Memory	:	Adequate for at least 2000 measurements
07.	Channels	:	At least six
08.	Printer	:	In built
09.	Analysis	:	As per international standard
10.	Enclosure	:	Stainless steel
11.	Accessories	:	• Battery charger • Process attachment • Carrying case
12.	Tractability	:	Yes
13.	Special feature	:	Display of environmental data such as humidity, temperature and air velocity

3.57.00 PORTABLE ULTRASONIC FLOW METER -(1 NO.)

- 3.57.01 02 (two) nos. of clamp on type portable Ultrasonic flow measuring instruments for measuring flow through any pipe sizes in between 10 to 2500 mm with an accuracy of $\pm 1\%$ of reading. Sensor shall be weather & dustproof conforming to

IP-65. Meter shall be programmable with alphanumeric display (LCD) and membrane type keyboard. Battery, Charger set and Temperature sensor shall also to be provided.

3.58.00 WET AND DRY BULB HYDROMETER - (1 NO.)

3.58.01 01 (one) no. of Wet and Dry Bulb Hydrometer with power supply from three 1.5 V alkaline batteries of reputed make shall be supplied. Measuring range shall be 10 to 95% Relative Humidity and ± 10 to 110° F with an accuracy of $\pm 0.3^{\circ}$ F. Wicks carrying case instruction set shall be supplied with the instruments.

3.59.00 ANEROID BAROMETER - (1 NO.)

3.59.01 01 (one) no. of Aneroid Barometer for measuring atmospheric pressure of reputed make.

01.	Range	:	28.3" to 31.8" Hg
02.	Accuracy	:	0.33% full scale
03.	Sensitivity	:	0.2% full scale
04.	Scale Length	:	16" through 1 pointer revolution
05.	Dial Diameter	:	4"/6"
06.	Dial calibration	:	Standard are mm Hg or inches Hg calibration in other units and two sets of graduations on a single dial.
07.	Min. Graduation	:	0.5mm or 0.02"

3.60.00 FLOW METER CALIBRATOR - (1 NO.)

01.	Accuracy	:	+ 2%
02.	Range	:	0 – 1000 mmwcl / 0-6000 mmwcl / 0- 30000 mmwcl
03.	Display	:	3 digit LCD

3.61.00 AIR SET -(1 NO.)

01.	Filter element	:	5 micron sintered bronze filter element
02.	Max. primary press	:	28 kg/cm ²
03.	Secondary pressure	:	0-2.1 kg/cm ²
04.	Connection	:	1/4" NPT (F)
05.	Accessory	:	O/P Gauge

3.62.00 MODULE TESTER -(1 NO.)

01.	Type	:	Latest version PC with windows based test software
02.	No. of channels	:	More than 48
03.	Power supply	:	Built in
04.	Loop test	:	Continuous
05.	Feature	:	Testing of memory devices, open collector devices, resistance, capacitance & voltage measurement, self test, diagnostic software, circuit tracer for IC links, extensive IC libraries
06.	Accessory	:	Standard set of Dip clips, probes, different type of connectors, ribbon cables etc.

3.63.00 DC REGULATED POWER SOURCE -(2 NOS.)

01.	Range	:	0 to $\pm 60V$ DC, 2.5A
02.	Display	:	LCD
03.	Power supply	:	240V AC, 1 Phase, 50Hz
04.	Mode Indication	:	LED indication for constant voltage/ constant current operating mode
05.	Load Regulation	:	(i) 0.1% variation in voltage (ii) 0.2% variation in current
06.	Ripple and Noise	:	Less than 1mV
07.	Resolution	:	50 mv/ ma
08.	Features	:	Overvoltage protection/ Overcurrent protection
09.	Accessories	:	Test lead

3.64.00 WELDING MACHINE -(1 NO.)

01.	Type	:	Portable
02.	Welding Process	:	Arc welding through hand welding electrode (coated wire or rod)
03.	Power supply	:	240V AC, 1 Phase, 50Hz

04. Accessories : Electrode cable

3.65.00 JEWELLERS LATHE -(1 NO.)

01. Type : Paddle/ Motor operated
02. Feature : High precision cutting
03. Power supply : 240V AC, 1 Phase, 50Hz

3.66.00 GRINDING MACHINE -(1 NO.)

01. Type : Motor operated adjustable speed
02. Feature : Different grade grinding wheel
03. Power supply : 240V AC, 1 Phase, 50Hz

3.67.00 FEELER GAUGE - (1 NO.)

01. Type : Sets of feeler of different size

3.68.00 PRECISION INSTRUMENT RADIAL DRILLING MACHINE - (1 NO.)

01. Type : Motor operated
02. Mounting : Desk
03. Power supply : 240V AC, 1 Phase, 50Hz
04. Accessories : Drill bits of different size

3.69.00 PORTABLE DRILLING MACHINE - (1 NO.)

01. Drilling capacity : 6 mm
02. Drilling depth : 25 mm
03. Power supply : 240V AC, 1 Phase, 50Hz
04. Mounting : Cast iron base on hard chrome-plated column

3.70.00 AUTO TRANSFORMER - (1 NO.)

01. Capacity : 15A, 8A

- 02. Input : 0-550V, 50Hz
- 03. Output : 0-270V continually adjustable through knob
- 04. Scale : (i) Voltage scale around voltage varying knob
(ii) White lettering and graduation as black background
- 05. Accessories : Test lead wires

3.71.00 UNIVERSAL DIGITAL THERMOMETER - (1 NO.)

- 01. Type : Portable and Digital
- 02. Range : (-) 50 to 1200°C
- 03. Type of element : RTD (Pt-100) & Thermocouple (Type: K,S,J,T,E,R,B and N)
- 04. Display : LCD
- 05. Power Supply : Battery operated

3.72.00 LOW AND MEDIUM PRESSURE CONTROLLER - (1 NO.)

- 01. Range : 0-2 kg/cm² (Low), 0-20 kg/cm² (Medium)
- 02. Accuracy : 0.05% or better

3.73.00 NICKEL CADMIUM CELL - (1 NO.)

- 01. Cell Type : Ni-Cd
- 02. Voltage Range : To suit supplied Laboratory instruments
- 03. Power Supply : 240V AC, 1 Phase, 50Hz
- 04. Charger suit : Yes

3.74.00 PORTABLE PNEUMATIC/ HYDRAULIC CALIBRATOR - (1 NO.)

- 01. Accuracy : 0.1% Full Scale
- 02. Indication : 4 1/2 digit LCD
- 03. Pump Range : (i) (-)1 to 0 Bar (Pneumatic type)

(ii) 0 to 20 Bar (Hydraulic type)

(iii) 0 to 200 Bar (Hydraulic type)

04. Control : Volume control with fine adjustment through vernier
05. Display range : 0-24 mA
06. Power supply : In built rechargeable battery

3.75.00 BENCH VICE & HAND VICE - (1 NO.)

[A] Bench Vice

01. Type : Bench mounted
02. Purpose : For instrumentation work

[B] Hand Vice

01. Type : Portable
02. Purpose : For instrumentation work

3.76.00 VACUUM CLEANER - (1 NO.)

01. Type : Portable
02. Vacuum : 2000 mm Wcl
03. Power supply : 240V AC, 1 Phase, 50Hz
04. Accessories : All purpose nozzle, radiator brash, jet air nozzle etc.

3.77.00 INFRARED PYROMETER - (1 NO.)

01. Type : Hand held non contact infrared technique
02. Temperature Range : 200-1800°C
03. Display Resolution : 1°C
04. Ambient Temperature : 0-50°C
05. Power supply : Battery operated
06. Accessories : Battery charger kit, Case

3.78.00 ANEMOMETER (PORTABLE TYPE) - (1 NO.)

- 01. Type : Portable
- 02. Display : LCD backlit display, Simultaneous display of ambient temperature, air flow/ velocity
- 03. Accessories : Battery, Battery charger kit, Carrying Case

3.79.00 COMPUTERISED CALIBRATION SYSTEM - (1 NO.)

This shall be located on test bench.

- 01. Processor : Latest available version from Pentium
- 02. SD RAM : 2 GB (Min)
- 03. Hard Disk : 500 GB (RAID)
- 04. Monitor : 21" (TFT)
- 05. Printer : A3 color laser jet
- 06. Power supply : 240V AC, 1 Phase, 50Hz
- 07. Other feature : USB Port, Serial/ parallel Ports, R/W DVD, 10/100 Mbps Ethernet port, Mouse, KB
- 08. Software : Licensed version of all necessary software

3.80.00 SCREW GAUGE - (1 NO.)

- 01. Spindle : Stainless steel
- 02. Accessory : Ratchet lock nut

3.81.00 SCANNER - (1 NO.)

- 01. Type : Electronic

3.82.00 GRINDING WHEEL - (5 NO.)

- 01. Type : Abrasive type

3.83.00 TORXIMETER - (2 NO.)

- 01. Application : Used for bolt torquing, torque wrench calibration, contact closure measurement

02. Feature : 3 units of measurement hold, peak, min-max, fast/ slow sampling, hi/ low resolution, auto power off

03. Accessories : Hard carrying case, torque probe, cable, battery along with battery charger etc.

3.84.00 PITOT TUBE - (2 NO.)

01. Material : Stainless Steel

3.85.00 LAPTOP - (2 NO.)

01. Processor : Latest or Core i5 (min)

02. RAM : 2 GB (min)

03. Hard Drive : 1 TB

04. Multimedia Drive : DVD+/-RW

05. Display : 15.6"

06. Network Card : Yes

07. Keyboard : Yes

08. Pointing Device : Touch pad

09. External Port : 3 nos (min) USB compliant port

10. Operating System : Latest available version

11. Software : Liscenced version of all necessary software

12. Accessory : Carrying case , additional battery along with battery charger

3.86.00 VIBRATION CALIBRATOR (PROXIMITY & SEISMIC PROBE) – (1NO.)

01. No of channel : 2 Analog+1 Auxiliary

02. Continuous battery operation : Up to 12 hour

03. PC Communication Interface : USB

04. Display : LCD

- 05. Max input signal range : $\pm 20V$
- 06. Frequency Range : 0-40 KHz
- 07. Protection class : IP-65
- 08. Accessories : Probe, pick up cable, carrying case, battery & battery charger etc

3.87.00 PORTABLE mA CALIBRATOR – (3 NO.)

- 01. Type : Microprocessor based
- 02. Application : To measure or source mA signal for calibration of receiver type instruments
- 03. Range : 0-24 mA
- 04. Resolution : 0.001
- 05. Accuracy : 0.001%
- 06. Measure Volts : 0 to 60 V
- 07. Accessories : Test lead, rechargeable battery with battery charger, carrying case etc

3.88.00 TABLE MOUNTED mA CALIBRATOR – (2NO.)

- 01. Input range : 0 to ± 100 mA DC, 0 to ± 1200 mV , 0 to ± 80 V (Programmable)
- 02. Output range : 0 to 25 mA DC, 0 to ± 1200 mV , 0 to 10 V (Programmable)
- 03. Accuracy : $\pm 0.03\%$ of reading
- 04. Temperature : 0-50°C
- 05. Accessories : Test lead, power cord, carrying case etc

3.89.00 PORTABLE mV CALIBRATOR – (2NO.)

- 01. Input range : 0 to 120 mV , 0 to 30 V (Programmable)
- 02. Output range : 0 to 120 mV , 0 to 12 V , 0 to 30 V, 0 to 24 mA (Programmable)
- 03. Accuracy : $\pm 0.02\%$ of reading
- 04. Temperature : 0-50°C

05.	Preferred feature	:	Reference junction compensation for thermocouple, over voltage/ current protection
06.	Accessories	:	Test lead, rechargeable battery with battery charger, carrying case etc
- 3.90.00 **TEST RTD – (2NO.)**
- | | | | |
|-----|-------------|---|--------------------------|
| 01. | Sensor type | : | Platinum resistance |
| 02. | Temperature | : | 0-600°C |
| 03. | Accessories | : | Cable, carrying case etc |
- 3.91.00 **TEST THERMOCOUPLE – (2NO.)**
- | | | | |
|-----|-------------|---|--------------------------|
| 01. | Sensor type | : | All type of thermocouple |
| 02. | Temperature | : | 0-1200°C |
| 03. | Accessories | : | Cable, carrying case etc |
- 3.92.00 **FREQUENCY COUNTER/ TIMER – (1NO.)**
- | | | | |
|-----|-------------|---|---|
| 01. | Bandwidth | : | 350 MHz |
| 02. | Display | : | 12 digit |
| 03. | Temperature | : | 0-50°C |
| 04. | Accessories | : | Battery with battery charger, carrying case etc |

NO DEVIATION CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,
(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,
Sub : No Deviation Certificate
Ref : 1) NIT/Tender Specification No:.....,
2) All other pertinent issues till date

We hereby confirm that we have not changed / modified / materially altered any of the tender documents as downloaded from the website/ issued by BHEL and in case of such observance at any stage, it shall be treated as null and void.

We also hereby confirm that we have neither set any Terms and Conditions and nor have we taken any deviation from the Tender conditions together with other references applicable for the above referred NIT/Tender Specification.

We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and opening of price bid submitted in the E-tendering portal <https://eprocurebhel.co.in>.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)