TECHNICAL CONDITIONS OF CONTRACT (TCC)

Bharat Heavy Electricals Limited



CONTENTS

Sl. No.	DESCRIPTION	Chapter	No. of Pages
Vol I A	**Part-I: Contract specific details**		
1	Project Information	Chapter-I	01
2	Scope of works	Chapter-II	05
3	Facilities & Consumables in the scope of Contractor / BHEL (Scope Matrix)	Chapter-III	10
4	T&Ps and MMEs to be deployed by Contractor	Chapter-IV	08
5	T&Ps and MMEs to be deployed by BHEL on sharing basis	Chapter-V	03
6	Time Schedule	Chapter-VI	03
7	Terms of Payment	Chapter-VII	03
8	Taxes and Duties	Chapter-VIII	02
9	Weight schedule/BOQ	Chapter-IX	21
10	General	Chapter-X	12
11	Foundations, Grouting and Civil Works	Chapter-XI	02
12	Material Handling, Transportation & storage	Chapter-XII	03
13	Scope of works-Detailed	Chapter-XIII	28
14	Progress of work	Chapter-XIV	02
15	Testing and Commissioning	Chapter-XV	04
16	Painting	Chapter-XVI	03
Vol IA	**Part-II: Technical specifications**		
1	Painting schedule	Chapter-1	02
2	Data Sheet	Chapter-2	01
3	Technical Requirements and Guidelines for Installation, Testing, Commissioning and Supply items of Electrical package	Chapter-3	34
4	“HSE Plan for Site Operations by Subcontractor” (Document No. HSEP: 14 Rev01)	Chapter-4	82
5	T&P Hire Charges (Valid up to 31.08.2023)	Chapter-5	12
6	List of Drawings & Scheme Drawings	Chapter-6	09

VOLUME-IA PART – I CHAPTER – I

PROJECT INFORMATION

1.1	Project Title	:	2X660 MW Udangudi Super Critical Thermal Power Project
1.2	Plant Capacity	:	2x660 MW
1.3	Type of Project	:	Green Field
1.4	Owner	:	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
1.5	Plant Site Location	:	Kallamoli – 628 203, Thiruchendur (Taluk), Tuticorin (Dt), Tamilnadu
1.6	Nearest Village	:	Udangudi
1.7	Nearest Town & City	:	41 km from Tuticorin
1.8	State Capital	:	Chennai at 481 km
1.9	Nearest Railway Station	:	Thiruchendur at 8 km
1.10	Nearest Airport	:	Tuticorin Domestic Airport at 41 km
1.11	Nearest Seaport	:	Tuticorin Port at 45 km
2.0	Meteorological Condition		
2.1	Climate	:	Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
2.2	Site Elevation	:	+ 2.8 m above MSL
2.3	**Ambient Temperature**		
a.	Annual Max. Mean Temperature	:	41^0 C
b.	Annual Min. Mean Temperature	:	22.3^0 C
c.	Dry Bulb Temperature (DBT) for Design Purpose	:	Max 41^0 C & Min 17^0 C
2.4	Relative Humidity for Design Purpose	:	62-84 %
2.5	**Annual Rainfall**		
	Average	:	384.4 mm to 718.2 mm
2.6	Basic Design Wind Pressure	:	As per IS: 875 (Latest Edition)
2.7	Wind Speed	:	11.8 kmph (Avg), 50 m/s (max)
2.8	Seismic Zone	:	Zone-II as per IS-1893-2002 (Part- IV)

VOLUME-IA PART – I CHAPTER – II

SCOPE OF WORKS

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.)

1.2. The scope of work covers Erection, Testing & Commissioning including Handling of materials at site BHEL stores / storage yard, transporting to site of erection and supply & application of final painting of HT Electrical works for Unit -1 and Unit-2 of 2 x 660MW Udangudi Super Critical Thermal Power Project at Tuticorin Dt., Tamil Nadu

1.2.1. The scope of works consists of two packages:

- **Package 1:** Erection, Testing & Commissioning including Handling of materials at site BHEL stores / storage yard, transporting to site of erection and supply & application of final painting of HT Electrical works for Unit-1 (Main plant) and identified BOP areas
- **Package-2:** Erection, Testing & Commissioning including Handling of materials at site BHEL stores / storage yard, transporting to site of erection and supply & application of final painting of HT Electrical works for Unit-2 (Main plant)
- **Both the packages (Package 1 and Package 2) will be awarded to only ONE successful bidder. However, Package 1 and Package 2 shall be treated as separate contracts**.

1.2.2 SCOPE OF WORKS COMMON FOR PACKAGE-1 & PACKAGE-2:

The broad scope of HT Electrical works covered in this tender are Erection and Commissioning of Transformers (all types), HT Switchgears, HT Bus Ducts, Generator Circuit Breaker, Generator Control Panel and commissioning of Generator, HT Drives, start up control Panels, including Permanent Nomenclature of individual feeders & Panels etc and not limited to the following. Detail Scope is as mentioned in the BOQ and elsewhere in this specification.

1. **Erection, Testing and Commissioning of:**
   a. All kind of Power Transformers including but not limited to the following:

(i) Generator Transformer (GT)/Station Transformer(ST)/Unit Transformer (UT): The tank of these transformers are unloaded in the rail of the Transformer Yard by BHEL. Bidder has to drag them to the respective foundation. All the other parts and accessories of these Transformers (GT, ST& UT) are stored in the storage yard which is approximately 2 km from the foundations. Bidder scope also includes transportation of these items from the storage yard up to the foundation.

(ii) All the other Transformers including dry type and oil type are stored in the storage yard which is approximately 2 km from their erection location. Bidder scope includes transporting from the storing location and shifting/dragging to the respective transformer foundations

(iii) During every filling of Oil from storage tank to transformer, required testing of oil shall be carried out in NABL accredited labs if required within the quoted price.

(iv) Transformer Oil drain piping works upto the tank/collection sump as required.

(v) Completion of Structural/Tray/Piping works if any required.

b. 11 kV & 6.6 kV Switchgears, DAVR

c. HT Bus Ducts (IPBD & SPBD) 11 kV & 6.6 kV.

d. Protection Panels of Generator, Generator Transformer, Startup transformer, Unit Transformer & Station Transformer, other Electrical Protection, generator circuit breaker (GCB) and Control Panels.

e. Utility Transformers and Unit auxiliary transformers.

f. Laying and termination of HT cables (11 kV & 6.6 kV) including supply of ferrules, tag plates, and cable dressing materials as detailed in scope of cabling. Arranging required capacity of portable DG set to cater power supply for carrying out tray and cabling works for equipment located at long distance.

g. Fabrication and installation of steel supports wherever required.

h. Erection of earth flats and earth pits for above ground earthing of HT equipment.

i. Installation of other items that have not been specifically indicated, but required for completing installation.

2. Commissioning of the following which are erected by other contractor

a. 660 MW generator,

b. HT motors,

c. LT motors,

d. Bi-Directional Drives, Control panels, insulators, special instruments, etc. erected by Mechanical/other contractor.

Note: If any peripheral Electrical item associated with the above said main equipment which was not erected by other contractor but it is required for complete commissioning shall be erected and commissioned by the contractor.

3. Others:

a. Painting including supply of paints, as detailed in scope of respective item/ equipment.

b. Contractor shall have valid electrical license to carry out the work indicated in the BOQ.

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

1.2.3 **SCOPE OF WORKS SPECIFIC TO PACKAGE-1:** Detail Scope is as mentioned in the BOQ and elsewhere in this specification.

1. Erection, Testing and commissioning of Power Transformers including but not limited to the following.

   a. **Standby Maintenance Transformers (Total 1 Nos.):**

      The tank of these transformers are unloaded in the rail of the Transformer Yard by BHEL. Bidder has to drag them to the respective foundation. All the other parts and accessories of these Transformers (GT, ST& UT) are stored in the storage yard which is approximately 2 km from the foundations. Bidder scope also includes transportation of these items from the storage yard up to the foundation.

   b. During every filling of Oil from storage tank to transformer, required testing of oil shall be carried out in NABL accredited labs if required within the quoted price.

   c. Transformer Oil drain piping works up to the tank/collection sump as required.

   d. Completion of Structural works if any required.

2. 33 kV HT Switchgears & 19/33 kV HT Cabling

1.2.4 **Scope of bidder also covers on getting Electrical Inspector/statutory authority's approval for charging of all HT installations erected by them.**

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

1.2.6 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.

1.2.7 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.

1.2.8 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.

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-VIII.*** *The rate schedule is the summary of BOM i.e. consolidated list of BOM.*

VOLUME-IA PART – I CHAPTER – III

FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL

Sl.No.	Description	Scope of BHEL	Scope of Bidder	Remarks
1.3.1.0				
1.3.1.1	**FOR CONSTRUCTION PURPOSE:**			
1.3.1.1.1	Open space for office	Yes		
1.3.1.1.2	Open space for storage	Yes		
1.3.1.1.3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
1.3.1.1.4	Bidder's all office equipment, office / store / canteen consumables		Yes	
1.3.1.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
1.3.1.1.6	Firefighting equipment like buckets, extinguishers etc.		Yes	
1.3.1.1.7	Fencing of storage area, office, canteen etc. of the bidder		Yes	
1.3.1.2	**FOR LIVING PURPOSES OF THE BIDDER**			
1.3.1.2.1	Open space		Yes	
1.3.1.2.2	Living accommodation		Yes	
1.3.1.3	**ELECTRICITY**			
1.3.1.3.1	Electricity For construction purposes (to be specified whether chargeable or free)			
1.3.1.3.1.a	Single point source	Yes		Chargeable
1.3.1.3.1.b	Further distribution for the work to be done which include supply of materials and execution		Yes	
1.3.1.3.2	Electricity distribution for the office, stores, canteen etc. of the bidder within the plant premises		Yes	

Sl.No.	Description	Scope of BHEL	Scope of Bidder	Remarks
1.3.1.3.2.a	Distribution from single point including supply of materials and service		Yes	
1.3.1.3.2.b	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
1.3.1.3.2.c	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.3.2.d	Demobilization of the facilities after completion of works		Yes	
1.3.1.3.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc.		Yes	Refer Cl.No. 1.3.4.2
1.3.1.4	**WATER SUPPLY**			
1.3.1.4.1	For construction purposes:	Yes		Chargeable
1.3.1.4.2	Making the water available at single point	Yes		Chargeable
1.3.1.4.3	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.5	**Water supply for bidder's office, stores, canteen etc. within the plant premises**			
1.3.1.5.1	Making the water available at single point		Yes	
1.3.1.5.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.6	**LIGHTING**			
1.3.1.6.1	For construction work (supply of all the necessary materials) At office storage area, At the preassembly area, At the construction site/area		Yes	

Sl.No.	Description	Scope of BHEL	Scope of Bidder	Remarks
1.3.1.6.2	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	**COMMUNICATION FACILITIES for site operations of the bidder**			
1.3.1.7.1	Telephone, Fax, internet, internet, email etc. (min 2 Nos of PC & Printer) – 2 Data entry operator with computer knowledge		Yes	
1.3.1.8	**COMPRESSED AIR SUPPLY**			
1.3.1.8.1	Supply of Compressor and all other equipment required for compressor & compressed air system including pipes, valves, storage systems etc		Yes	
1.3.1.8.2	Installation of above system and operation & maintenance of the same		Yes	
1.3.1.8.3	Supply of the all the consumables for the above system during the contract period		Yes	
1.3.2.0				
1.3.2.1	**Engineering works for construction**			
1.3.2.1.a	Providing the erection drawings for all the equipment covered under this scope	Yes		
1.3.2.1.b	Drawings for construction methods		Yes	In consultation with BHEL
1.3.2.1.c	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

Sl.No.	Description	Scope of BHEL	Scope of Bidder	Remarks
1.3.2.2	Shipping lists etc for reference and planning the activities	Yes	Yes	In consultation with BHEL
1.3.2.3	Preparation of site erection schedules and other input requirements		Yes	
1.3.2.4	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments	Yes		
1.3.2.5	Weekly erection schedules based on Sl No. 4		Yes	In consultation with BHEL
1.3.2.6	Daily erection / work plan based on Sl No. 5		Yes	In consultation with BHEL
1.3.2.7	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
1.3.2.8	Preparation of preassembly bay		Yes	
1.3.2.9	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 his 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 Labour/staff and the contractor has to make their own arrangements. Contractor has to make their own arrangements for labour colony.

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

Construction power prevailing charges are as below,

The present LT tariff VI rate of TANGEDCO is:

a. Consumption charges at Rs.12.00 per unit
b. Maximum demand (MD) charges as applicable per month
c. Low Power Factor (LPF) charges
d. Electricity Tax on total amount
e. Any other miscellaneous charges charged by M/s TANGEDCO pertaining to construction power supply.

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

1.3.4.2 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.

1.3.4.3 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.

1.3.4.4 The required energy meter for measuring power consumption shall be arranged by the contractor and taken care by the 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 0.9 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 if Electricity is not provided by TANGEDCO.

1.3.4.8 As there are bound to be interruptions in regular power supply, power cut/load shedding in any construction sites/non availability of power source near work area, 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 required for construction purposes will be provided at one single point within the plant area on chargeable basis from the nearest storage tank located inside the plant area at the prevailing rates of TANGEDCO / Metro water. The required water meter for measuring the consumption shall be provided and installed by the contractor. The required pumps & accessories, pipes for drawing water from the storage tank and further distribution will be arranged by the contractor at their cost.

1.3.5.2 The water charges may vary from time to time as per TANGEDCO / Metro water conditions, however the prevailing water charge is Rs.191.00 per 1000 litres. Any dispute regarding consumption, the BHEL engineer decision will be final. In case of non-availability of water, the contractor shall make their own arrangements of water suitable for construction 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 his water requirement for his labour colony at their cost.

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.

1.3.5.4 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]:**

1.3.7.1 Two Nos of computers and Multi-Function Printers (MFP) of latest configuration (preferably i5 processor, 8 GB Ram, 1 TB Hard disk, with internet provision on all the computers), along with one data entry operator per computer to be arranged by contractor for reporting of daily progress, billing and other similar activities, updating details in online SCMS package of BHEL, etc., within the quoted rate.

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 Only TIG welding wires for CS, AS & SS welding will be supplied by BHEL free of cost for Boiler for applicable Pressure Parts as provided by manufacturing units. All other electrodes including stainless steel electrodes required for shall be arranged by the contractor at their cost. However, BHEL will provide imported electrodes as provided by manufacturing units. The bidder shall use the Customer approved quality welding electrodes only. The utilization of the TIG welding wires issued by BHEL shall be duly accounted for exercising maximum care and ensuring economical usage for minimum wastage. If during erection, it is found that the consumption of filler wire is more than the actual requirement due to improper usage, the cost for the additional quantity so consumed shall be recovered from the contractor.

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:

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

1.3.10 POSSESSION OF GENERATORS:

1.3.10.1 As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, suitable extension of time, if found necessary 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):

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

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:

1.3.14.1 Adequate water less 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 a 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.,
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
9. Anchor fasteners for wall mounted cable trays & JBs wherever required.

1.3.16 POWER REQUIREMENT:

1.3.16.1 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.

1.3.17 CONTRACTOR'S OBLIGATION ON COMPLETION:

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

VOLUME-IA PART – I CHAPTER – IV

T&PS AND MMES TO BE DEPLOYED BY CONTRACTOR

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 Tentative list of Major T&P shall be deployed for execution within quoted Price:

a. Oil Filtration Machine with all accessories 10 to 12 KL/hr capacity for GT& SUT: 1 No

b. Oil Filtration Machine with all accessories 5 to 6 KL/hr capacity: 1 No

c. 40 KL capacity oil storage tank with all accessories – 2 Nos

d. Sufficient quantity of Nitrogen Gas (with 99.999% purity and Dew point-50 or better) has to be arranged for top up during preservation of Transformers till the oil filling.

e. Mobile Crane 14 T capacity – 01 Nos. (min)

1.4.2 The list of T&P requirements mentioned in Cl.No. 1.4.1.0 above is "Tentative and not exhaustive". It is indicated by considering the parallel working in all areas mentioned in the 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 / equipments 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 equipments. 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.

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

1.4.4 **EQUIPMENT REQUIRED FOR TESTING, COMMISSIONING & OPERATION:**

The tentative list of testing equipment shall be arranged by contractor in sufficient number to carry out the job simultaneously in more than one area.

- Sufficient quantity of ARC FLASH suits suitable for HV voltages to be arranged by contractor for personnel involved in the testing, commissioning and initial O&M of HV Electrical equipment

- Insulation tester:

  a) Motorized Megger - 0 - 1000 - 2000 - 5000V, 0 - 25000 M ohms (make: Kyoritsu) with PI option.

  b) Hand operated Megger - 0.5 KV/1.0 KV/2.5 KV, 0- 1000 M Ohms

- Earth resistance tester 0 to 1, 10, 100 ohms
- Transformer oil test kit
- Torque wrench
- Voltmeter AC 0 - 125 - 250 - 625 V AC
- Ammeter AC 0 - 2A - 10A AC
- Wattmeter - ac/dc - 0 - 125 - 250 V 0-5-10A.
- Multimeter - analogue: AC V 2.5V - 2500V, AC A - 100 mA - 10 A
  DC V 25.V - 2500V, dc A - 50mA - 10A
- Digital Multi meters (make: Fluke) AC 0V-600V, DC 0V-300V
- Resistance - 0 - 200 M ohms
- Digital: voltages AC & DC - 100mv - 1000 V

  Current 10-mA - 10A Resistance - 0-20 M ohms

- HT cables Fault locator
- HT cable straight through jointing kits – 02 Nos (min) for each cable sizes
- HT cables jointer for straight through jointing and end termination on 24x7 basis
- High vacuum oil filtering machine of 5 to 6 KL/hr (1 no) and 1KL/Hr for transformer dry out.
- VARIAC - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A.
- Primary injection kit - 0-10000 A.
- Relays testing kit for Secondary injection test (Make: Omicron)- 0-5A.
- HV Test kit - 50 KV AC 400kVA.
- Wheat stone bridge - 0.05 m ohm - 100 ohm.
- Oscilloscope
- Air compressor.
- Oil Tank for transformer oil filtration

- Winding inductance/capacitance test kit
- 220V DC power pack for control supply required for testing of panels
- Vacuum pump.
- Phase sequence meter - 110V - 450V - 25 to 65Hz.
- Frequency meter - 0 - 115 - 230 - 4500 - 45 - 601/s.
- Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.
- Tachometer etc.
- SF6 filling and evacuating equipment.
- mA Source
- Standard pressure gauges – If required
- Temperature oil bath– If required
- Tan Delta Test kit- Only if HV transformers are included in rate schedule
- Oil specific gravity and PPM measuring Equipment-Only if HV Transformers are included in rate schedule
- Dew point measurement instrument
- 3 Phase relay testing kit (Of type omicron etc.) To be brought when required
- Contact resistance measurement kit
- Micro Ohm meter
- Equipment's for SFRA Test (400 KV on either side)
- Equipment for DGA test on Transformers (Guidelines attached in elsewhere in this specification)
- HT discharge rod (min 11 kV) – 3 Sets (min)
- Lockout Tagout (LOTO) system for implementing during testing, commissioning & initial operation of Electrical equipment
- Insulating Rubber mats & Hand gloves (as required)

Note: *The list 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.*

1.4.5 ACCURACY REQUIREMENT OF TESTING INSTRUMENTS

S.No.	INSTRUMENT / TOOL	RANGE	ACCURACY
1	Power Pack	0 to 50V DC, 3A	± 2%
2	Analog Multimeter	Voltage 2.5 to 2500V AC	± 1.0%
		Current 100 mA to 10A AC	± 2.0%
		Current 250 micro A to 1A DC	± 1.5%
		Resistance up to 100 ohms	± 3.0%
		Voltage 2.5V to 2500V DC	± 1%
3	Digital Multimeter	Voltage 200mV to 1000 V DC	± 1% + 1 digit
		Philips Voltage 200mV to 1000 V AC	± 1% + 1 digit
		Hcl Current 200mA to 20 A AC	± 0.8% + 1 digit
		Philips Current 20 mA to 20 A AC	± 0.8% + 1 digit
		Resistance (Hcl) 2120 200* to 200M*	± 0.5% + 1 digit
		Resistance (Hcl) 2105 200* to 200M*	± 0.25% + 1 digit
		Hcl Voltage 200mA to 750 V	± 0.8% + 1 digit
		Philips Current 20 mA to 20 A DC	± 0.5% + 1 digit
		Hcl Current 200 mA to 010 A AC	± 1% + 1 digit
4	Vibration Measuring Equipment	Velocity up to 50 mm/sec.	± 0.5% mm/sec
		Displacement up to 300 microns	± 2 microns
5	Secondary Injection Kit	Up to 5A	± 0.5mA
6	Motor operated Megger	up to 200 Ohms	± 5% at Centre scale
7	Tongue tester	0/300/600A AC	± 5%
		0 to 300A DC	± 5%

8	Tachometer (Hand held)	0 to 4000 rpm	+ 5%
9	Phase Sequence Meter		N/A
10	Three Phase Variac	15 A Capacity	N/A
11	Feeler Gauges	300 mm long and 100 mm long	± 2 microns
12	Dial Gauges	0 to10mm	± 0.01 mm
13	Hand operated Megger 500V / 1000V/2.5 KV	Up to 1000 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
14	Motorized Megger 2.5 KV	Up to 1000 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
15	Earth Resistance tester (Tester)	0 to 1, 10 Ohms	± 5% at Centre Scale range
16	AC tongue Tester	0 to 1000A AC	± 3%
17	DC Tongue Tester	0 to 300A DC	± 5%
18	High Voltage test Kit	Up to 50 KV AC -50 ma capacity	± 10%
		Up to 70 KV DC	± 10%
19	DC Ammeter	0 to 300 A	
20	DC Voltmeter	0 to 500 V	
21	Micro Ohm meter	10A and 100 A	
22	Primary Injection kit	0-10000A	
23	Single Phase Variac	0-15 Amps	

24	Motor Direction tester		
25	DC Tong Tester (mA)	0-500 mA	
26	Contact Resistance Tester for Breaker contact Resistance measurement		
27	Motorized Megger 5kV	10000 Mega Ohms	

Note:

1. For loading and transportation, all necessary T & P such as Trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor. All the tools & plants required for this scope of work, except the tools & plants provided by BHEL are to be arranged by the contractor within the quoted rates.
2. **Note for Contractor's Instruments:**

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.

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.

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

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

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

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

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

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

1.4.7 In the event of non-mobilization 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) at the risk and cost of the contractor and hire charges shall be applicable as under:

Case 1: BHEL provides its own Capital T&P:

In case the BHEL provides any T&P which is owned by BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges.

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

Case 2: In all cases other than that specified in Case 1 above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor. The present rates of BHEL's Corporate Crane hire charge are enclosed as part of this tender. This may get revised further as per the BHEL corporate guidelines. The prevailing rates as on date of execution shall be applicable.

VOLUME-IA PART – I CHAPTER – V

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

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

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

1. EOT Crane at TG Hall without operator– 01 No.
2. Crawler Crane – 75T or above Capacity – 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. As the above crane is deployed for the purpose of shifting the panels within power house building on sharing basis at free of hire charges and also for various contractors. The decision of BHEL Engineers will be final with regard to allotment of crane.

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

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

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

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

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

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

1.5.9 BHEL's 75T (or above) Crane is only for erection purpose of GT, ST, UT, IP Bus Duct, GCB and its auxiliaries only and shall not be available for

material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.

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

1.5.11 BHEL may provide either BHEL owned or hired 75T (or above capacity) cranes at the discretion of BHEL.

1.5.12 In the event of providing BHEL owned cranes:

1.5.12.1 BHEL shall provide crane operator at free of charges.

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

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

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

1.5.13 In the event of providing hired cranes:

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

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

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

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

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

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

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

1.5.19 Apart from the above mentioned tools, any other tools and plants including suitable Jacks / Hydraulics jacks required for satisfactory completion of the work has to be arranged by the contractor. However, bidders may note that the Hydraulic jacks that are supplied by manufacturing units for alignment of Generator Stator, if any shall be made available to TG contractor for the said purpose.

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

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

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

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

VOLUME-IA PART – I CHAPTER-VI

TIME SCHEDULE

1.6.1 TIME SCHEDULE

1.6.1.1 The entire work of erection testing and commissioning of each package as detailed in the Tender Specification shall be completed within **20 (Twenty)** months from the date of commencement of work at site. Phase shift between Package-1 & Package-2 is 02 months.

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

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

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

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

Milestone Activity (For each Package)	For each Package
1. Start of work	1st Month
2. Readiness for Boiler Light Up	7th Month
3. Readiness for Synchronization	11th Month
4. Trial Operation	14th Month
5. Balance work completion, pending points, punch points liquidation	20th Month

Intermediate Milestone Activity	For each Package
1. Readiness for Boiler Light Up (M1)	7th Month
2. Readiness for Synchronization (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 Milestones for respective works under each package.

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

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

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

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

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

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

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

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

1.6.5. CONTRACT PERIOD

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

1.6.6. GUARANTEE PERIOD FOR EACH PACKAGE

1.6.6.1 The guarantee period of 12 months shall commence from the date of handing over of the Unit to Customer (or) Six months from the date of synchronization of the unit, whichever is earlier. (Provided all erection, testing, commissioning and pending points works are completed in all respects).

VOLUME-IA PART – I CHAPTER-VII

TERMS OF PAYMENT

Terms of Payment:

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

	Progressive Payment against monthly running bills will be made up to 85 % of the value of **the completed erection** on Pro rata as per Clause no 1.7.1 to 1.7.1.10.5 of the following table.	
Sl. No.	**Activity / Work Description**	**% of unit rate**
1.7.1	**PRO RATA PAYMENTS (85%)**	
1.7.1.1	**Cable tray and accessories**	
1.7.1.1.1	Fabrication and fixing / welding / bolting in position	60%
1.7.1.1.2	Earthing of cable trays	10%
1.7.1.1.3	Tagging of cable trays (including touch up painting & cable tray numbering on sides)	8%
1.7.1.1.4	Covering of trays where ever envisaged	7%
	Total =	**85%**
1.7.1.2	**Cable laying including Earthing wires**	
1.7.1.2.1	Laying of cables / Wires	45%
1.7.1.2.2	Glanding and termination (except HT terminations)	15%
1.7.1.2.3	Testing and charging	10%
1.7.1.2.4	Dressing and clamping	15%
	Total =	**85%**
1.7.1.3	**Junction box/Push button station (local)**	
1.7.1.3.1	Erection including fixing of terminal blocks where ever applicable	75%
1.7.1.3.2	Name plate fixing where ever applicable and labelling (inside and outside)	10%
	Total =	**85%**
1.7.1.4	**Misc. Structural steel including cable tray supports, Canopies etc., Conduits, pipes etc.**	
1.7.1.4.1	Fabrication / Pre assembly	45%
1.7.1.4.2	Erection, Alignment, welding/bolting and if applicable chipping/grouting/painting	40%
	Total =	**85%**

1.7.1.5	**Switch Gears/ Distribution Boards / Marshalling Box / Starter Units / Dry Transformers / Electrical Hoists/ Panels / Cubicles / Desks / UPS / Batteries / Chargers / VFD / LA assy / NGT / NGR / SP/ Circuit breaker/ DAVR/ Miscellaneous Equipment/ etc.**	
1.7.1.5.1	Placement, Alignment and coupling / interconnection where ever applicable, erection of associated accessories etc	50%
1.7.1.5.2	Pre-commissioning checks and tests	10%
1.7.1.5.3	Charging, Loop testing and commissioning	15%
1.7.1.5.4	System commissioning	10%
	Total =	**85%**
1.7.1.6	**Earthing / Lightning protection strips, Earthing pits**	
1.7.1.6.1	Fabrication, erection, alignment, welding / bolting of earthing / lightning protection strips; earth pits Completion	60%
1.7.1.6.2	Testing / commissioning	25%
	Total =	**85%**
1.7.1.7	**HT Bus Ducts**	
1.7.1.7.1	Pre assembly of Bus Ducts and accessories, erection, alignment, bolting/welding etc. complete with supporting structure and earthing.	50%
1.7.1.7.2	Pre commissioning checks	20%
1.7.1.7.3	Testing, Charging	10%
1.7.1.7.4	Final Painting	5%
	Total =	**85%**
1.7.1.8	**Oil Filled Transformers (GT/SUT/ST/UT/UAT/SAT,etc) & All other service Transformers**	
1.7.1.8.1	Placement on foundation and alignment	25%
1.7.1.8.2	Erection of associated auxiliaries / assemblies, oil filling, earthing, including branch trays and piping work, etc.	25%
1.7.1.8.3	Dry out including oil filtration	15%
1.7.1.8.4	Pre-commissioning checks	10%
1.7.1.8.5	Testing, Charging	5%
1.7.1.8.6	Final Painting	5%
	Total =	**85%**
1.7.1.9	**Testing / Commissioning of Equipment (like LT/HT motors, actuators, ESP transformer, misc equipment, etc) erected by other agencies.**	

1.7.1.9.1	Local testing (Including oil filtration for ESP transformers)	40%
1.7.1.9.2	Remote testing, Loop testing, and commissioning	40%
1.7.1.9.3	System commissioning	5%
	Total =	**85%**
1.7.1.10	**Other items**	
1.7.1.10.1	Rubber mats / Display Boards / Miscellaneous items / etc : on installation	85%
1.7.1.10.2	Specialized Commissioning Services - on pro rata basis.	85%
1.7.1.10.3	Civil Works / structural works - Prorata on completion of actual work.	85%
1.7.1.10.4	Earthing of steel columns of Boiler, ESP, PH structures and any other structure columns	85%
1.7.1.10.5	Termination, HT Termination, Straight through jointing etc : on pro rata basis	85%
	Further 15 % payment on pro-rata basis common to all PG shall be released on achievement of the following stage / milestones events for the **erected items in the Unit** as mentioned in 1.7.4.0 of the following table.	
1.7.2	**STAGE / MILESTONE PAYMENTS (15%)**	**% of unit rate**
1.7.2.1	On receipt of certificate from Electrical inspector for energising equipment (Full system)	1%
1.7.2.2	Boiler Light Up	1%
1.7.2.3	ABO/EDTA cleaning	1%
1.7.2.4	Rolling and Synchronization	2%
1.7.2.5	Coal Firing	1%
1.7.2.6	Area cleaning and scrap removal	0.5%
1.7.2.7	Full Load	2%
1.7.2.8	Trial Operation of Unit	2.5%
1.7.2.9	Punch List points / pending points liquidation	1%
1.7.2.10	Submission of 'As Built Drawings'	1%
1.7.2.11	Monthly Material Reconciliation	1%
1.7.2.12	Completion of Contractual Obligation	1%
	Total for Stage / Milestone Payments (15%)	**15%**

Note:
NO CLAIM WHAT SO EVER MAY BE, WILL BE ENTERTAINED UNDER THIS CONTRACT, AFTER DULY SIGNING THE FINAL BILL ALONG WITH MEASUREMENT BOOKS AND ACCEPTED BY BHEL.

VOLUME-IA PART – I CHAPTER VIII
TAXES AND DUTIES

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 - 33AAACB4146P2ZL

NAME - BHARAT HEAVY ELECTRICALS LIMITED

ADDRESS - BHEL-PSSR SITE OFFICE, 2X660MW UDANGUDI SUPERCRITICAL THERMAL POWER STATION, KALLAMOLI VILLAGE, THIRUCHENDUR TALUK, THOOTHUKUDI DISTRICT, TAMIL NADU-628203

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., 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.

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

1.9. ELECTRICAL HT - BILL OF QUANTITY (BOQ)

1.9.1 BOQ of Package – 1

Sl.No.	DESCRIPTION	QTY	UOM
A	**BHEL-BHOPAL SCOPE OF SUPPLY**		
A.1	**HV TRANSFORMERS**		
A.1.1	275/220/165 MVA,(420/√3)/21 kV, 1 phase, OFAF/ONAF/ONAN cooled,YNd11 (after 3 phase bank), Generator Transformer (GT#1), Outdoor with Off Circuit tap changers (OCTC),HV/HVN/LV bushings, post insulators, neutral bushings, bushing CTs, Turrets, Conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories. Approximate Dimensions of each transformer (l x b x h): Overall Dimensions: 11765(L) x7535(B) x9790(H). Shipping Dimension of Largest package:6200(L) x4700(B) x4710(H). Weight of heaviest package - 203000kg approx. Weight of core and winding assembly-175000kg approx.; Weight of tank cover, tank, Radiators, A frame and fittings–50600 kg approx.; Total weight of the package including oil-296100 kg approx.; Insulating Oil Qty. - 54000 kg.approx.* Please refer TCC for scope and other details. Only Tanks of all the four GTs are unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the GT Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting.	4	SET
A.2	**33 kV SWITCHGEAR**		
A.2.1	SW intake & ECHS Switchboard 0AA - 33KV, indoor panel, metal clad, vacuum break switch gears of 630 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 11 panels of suitable 6 shipping sections. Over all panel sizes- 14300 (L) x 3248 (D) x2600(H) Weight of shipping for 1 panel - 1800 Kg(1300mm wide) approx. for shipping two panel - 3500 Kg approx.(1300mm + 130mm wide)	1	SET
A.3	**11 kV SWITCHGEAR**		
A.3.1	Unit Switchboard 1BA - 11KV, indoor panel, metal clad, vacuum break switch gears of 4000 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 22 panels of suitable 12 shipping sections. Over all panel sizes- 18220 (L) x 2927(D)X2805 (H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820mm + 820mm wide)	1	SET

A.3.2	Unit Switchboard 1BB - 11KV, indoor panel, metal clad, vacuum break switch gears of 4000 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 21 panels of suitable 11 shipping sections. Over all panel sizes- 17400 (L) x 2887 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx.& for two panel - 2600 kg (820mm + 820mm).	1	SET
A.3.3	Station Switchboard 0BA - 11KV, indoor panel, metal clad, vacuum break switch gears of 4000 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 17 panels of suitable 9 shipping sections. Over all panel sizes- 14120 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx. for shipping two panel - 2500 Kg approx.(820 + 820mm wide)	1	SET
A.3.4	Station Switchboard 0BB - 11KV, indoor panel, metal clad, vacuum break switch gears of 4000 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 17 panels of suitable 9 shipping sections. Over all panel sizes- 14120 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET
A.3.5	Standby Switchboard 0BC - 11KV, indoor panel, metal clad, vacuum break switch gears of 3150 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 21 panels of suitable 11 shipping sections. Over all panel sizes- 17720 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx. for shipping two panel - 2500 Kg approx.(820 + 820mm wide)	1	SET
A.3.6	Standby Switchboard 0BD - 11KV, indoor panel, metal clad, vacuum break switch gears of 3150 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 19 panels of suitable 10 shipping sections. Over all panel sizes- 15580 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx. for shipping two panel - 2500 Kg approx.(820 + 820mm wide)	1	SET
A.4	**6.6 kV SWITCHGEAR**		
A.4.1	Unit Auxiliary Switchboard 1CA - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 1250 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 27 panels of suitable 15 shipping sections. Over all panel sizes- 21920 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx. for shipping two panel - 2500 Kg approx.(820 + 820mm wide)	1	SET
A.4.2	Station Auxiliary Switchboard 0CA - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 630 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 20 panels of suitable 11 shipping sections. Over all panel sizes- 16180 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET

A.4.3	CHP Auxiliary Switchboard 0CB - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 1600 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 28 panels of suitable 15 shipping sections. Over all panel sizes- 22960 (L) x 2349 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET
A.4.4	AHP Auxiliary Switchboard 0CC - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 1250 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 36 panels of suitable 19 shipping sections. Over all panel sizes- 29300 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx. for shipping two panel - 2500 Kg approx.(820 + 820mm wide)	1	SET
A.4.5	RODM Auxiliary Switchboard 0CD - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 3500 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 30 panels of suitable 16 shipping sections. Over all panel sizes- 25580 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET
A.4.6	CHP Bunker Switchboard 0CE - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 630 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 21 panels of suitable 11 shipping sections. Over all panel sizes- 17000 (L) x 2873 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET
A.4.7	Ext.CHP Auxiliary Switchboard 0CF - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 1250 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 22 panels of suitable 11 shipping sections. Over all panel sizes- 17820 (L) x 2349 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET
A.4.8	Sea Water Intake Switchboard 0CG - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 630 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 28 panels of suitable 15 shipping sections. Over all panel sizes- 22960 (L) x 2349 (D) x2805(H) Weight of shipping for 1 panel - 1300 Kg(820mm wide) approx. for shipping two panel - 2600 Kg approx.(820 + 820mm wide)	1	SET
A.5	**INTERMEDIATE/SUPPORTING SWITCHGEARS & ACCESSORIES**		
A.5.1	Fast Bus Transfer System Panels for 11 KV SWGR size 800 (w) x 800 (d) x 2295 (h) weight 300 kg approx, along with accessories computers, printers, table, checking of pre-assembled LIUs, communication cables etc.	2	SET

A.5.2	Protection panel for Generator/GT/UT/ST with associated loose supplied items such as Laptop, PC, Printer, UPS, interconnecting cables, RJ45 cables etc. Size of the Panel: 800 (W) x800 (D) x 2295 (H) mm Approximate weight of the panel: 450 kg. Lump sum rate to be quoted.	8	SET
A.5.3	Data concentrator panel-1 for Unit-1 SWBD (11 kV Unit 1 & Station SWBD) at control room along with loose items size 800mm(W) x800mm(D) x 2000mm(H) approx weight 200kg	1	SET
A.5.4	Data concentrator panel-3 for Unit Aux & Station Aux. SWBD (6.6 kV) at control room along with loose items size 800mm(W) x800mm(D) x 2000mm(H) approx weight 200kg	1	SET
A.5.5	Data concentrator panel-4 for AHP, CHP & RODM SWBD (6.6 Kv) at control room along with loose items size 800mm(W) x800mm(D) x 2000mm(H) approx weight 200kg	1	SET
A.5.6	Data concentrator panel-5 for Sea Water Intake & CHP SWBD (6.6 kV) at control room along with loose items size 800mm(W) x800mm(D) x 2000mm(H) approx weight 200kg	1	SET
A.5.7	Loose items of Data concentrator system - HMI OWS computer with monitor - 3 nos, console table 75 KG (1000mm x 750mm x 574 mm) - 1 no, A4 colour printer - 1 no, UPS 1 KVA - 1 no, Ethernet switch - 12 nos, LIU - 10 nos, Laptop computer - 1 nos, Patch cards & RJ45 connecters reqd qty, GPS antenna along with cable, GPS receiver, GPS clock etc. Assembling of loose supply computer table, printer table, chairs etc	2	SET
A.5.8	33 kV -630 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	2	Nos.
A.5.9	11 kV -4000 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	2	Nos.
A.5.10	11 kV -2500 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	1	Nos.
A.5.11	6.6 kV - 2500 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	17	Nos.
A.5.12	OFC cable includes fixing of fibre optic components and termination kits LIU, face plates, cabinets, SC coupler, grounding etc	11000	Mtrs
A.5.13	OFC Splicing	75	Nos.
A.5.14	D link 4 pair PVC, CAT 5e LAN cable	6000	Mtrs
B	**BHEL-JHANSI SCOPE OF SUPPLY**		
B.1.0	**HV TRANSFORMERS**		

B.1.1	110/55/55 MVA, 400/11.5 -11.5 KV, 3 Phase, with ONAN/ONAF/OFAF cooled, YNyn0yn0, Standby Maintenance Transformer(SBT), Outdoor with On Load Tap Changers (OLTC) HV/HVN/LV1/LV2/LV1N/LV2N post insulators, neutral bushings, bushing CTs, Turrets, conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories, etc. Approximate Dimensions of transformer (LxBxH) : Overall Dimensions: 17600(L) x8500(B) x10160(H) approx. Shipping Dimension of Largest package :8100(L) x6860(B) x4700(H) approx. Weight of heaviest package – 123500 kg approx. Weight of core and winding assembly - 78000kg, weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers –60000 kg approx.; Total weight of the package-226800 kg approx.; Insulating Oil Qty. - 68000Ltrs.approx. Only Tank of this Transformer is unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting.	1	SET
B.1.2	56/70 MVA, 21 KV/11.5KV, 3 Phase, ONAN/ONAF cooled, Dyn1, Station Transformer(ST) Outdoor with On Load Tap Changers (OLTC) HV/LV/LVN post insulators, neutral bushings, bushing CTs, Turrets, conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories, etc. Approximate Dimensions of transformer (LxBxH) : Overall Dimensions: 9794(L) x7200(B) x6950(H) approx. Shipping Dimension of Largest package :3950(L) x2200(B) x5384(H) approx. Weight of heaviest package - 50000kg approx. Weight of core and winding assembly- 37000kg, weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers –28000kg approx.; Total weight of the package-86500kg approx.; Insulating Oil Qty - 28000 kg.approx.* Please refer TCC for scope and other details. Only Tank of this Transformer is unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting.	1	SET

B.1.3	56/70 MVA, 21 KV/11.5KV, 3 Phase, ONAN/ONAF cooled, Dyn1, Unit Transformer(UT) Outdoor with On Load Tap Changers (OLTC) HV/LV/LVN post insulators, neutral bushings, bushing CTs, Turrets, conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories, etc. Approximate Dimensions of transformer (LxBxH) : Overall Dimensions: 9794(L) x7200(B) x6950(H) approx. Shipping Dimension of Largest package :3950(L) x2200(B) x5384(H) approx. Weight of heaviest package - 50000kg approx. Weight of core and winding assembly- 37000kg, weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers –28000kg approx.; Total weight of the package-86500kg approx.; Insulating Oil Qty - 28000 kg.approx.* Please refer TCC for scope and other details. Only Tank of this Transformer is unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting.	2	SET
B.2.0	**MV Transformers**		
B.2.1	28/35 MVA, 11/6.9 kV, 3 phase, ONAN/ONAF/Dyn1, SEA WATER AUXILIARYTRANSFORMER (0CDT01 & 0CDT02), Outdoor with HV/LV/LVN Marshalling Box (1350(L)x465(B)x1450(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, Approximate Dimensions: a. Overall Dimensions: 8200(L) x7000(B) x6500(H) b. Shipping Dimension of Largest package:5600(L) x3300(B) x4400(H) Weight of heaviest package - 38500kg approx. Total Weight - 65800kg approx; Insulating Oil Qty - 17800kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting.	2	SET
B.2.2	20/25 MVA, 11/36 kV, 3 phase, ONAN/ONAF/Ynd11, EXTERNAL CHP TRANSFORMER (0AAT01 & 0AAT02), Outdoor with HV/LV/LVN Marshalling Box (1350(L)x465(B)x1450(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, Approximate Dimensions: a. Overall Dimensions: 7800(L) x6800(B) x6300(H) b. Shipping Dimension of Largest package:4800(L) x3000(B) x3200(H) Weight of heaviest package - 36500kg approx. Total Weight - 62000kg approx; Insulating Oil Qty - 15800kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted	2	SET

	for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting.		
B.2.3	16 MVA, 11/6.9 kV, 3 phase, ONAN/Dyn1, AHP AUXILIARY TRANSFORMER (AAT), Outdoor with HV/LV/LVN Marshalling Box (1150(L)x465(B)x1415(H)) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, a. Overall Dimensions: 7100(L) x5100(B) x5300(H) b. Shipping Dimension of Largest package:4400(L) x2400(B) x3000(H) Weight of heaviest package - 31700kg approx. Total Weight - 40000kg approx; Insulating Oil Qty - 11000kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting.	2	SET
B.2.4	12.5 MVA, 11/6.9 kV, 3 phase, ONAN/Dyn1, UNIT AUXILIARY TRANSFORMER (UAT) (1CAT01 & 1CAT02), Outdoor with HV/LV/LVN Marshalling Box (1150(L)x465(B)x1415(H)) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, a. Overall Dimensions: 7000(L) x5000(B) x6000(H) b. Shipping Dimension of Largest package:4400(L) x2500(B) x2900(H) Weight of heaviest package - 27000kg approx. Total Weight - 45000kg approx; Insulating Oil Qty - 11100kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting.	2	SET
B.2.5	2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type BOILER SERVICE TRANSFORMER (1DAT01 & 1DAT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:3000(L) x2115(B) x3100(H) Weight of Shipment:8000kg approx each.	2	SET
B.2.6	2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type STATION SERVICE TRANSFORMER (0DAT01 & 0DAT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:3000(L) x2115(B) x3100(H) Weight of Shipment:8000kg approx each.	2	SET
B.2.7	2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type ADMN BLDG. SERVICE TRANSFORMER (0DFT01 & 0DFT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:3000(L) x2115(B) x3100(H) Weight of Shipment:8000kg approx each.	2	SET

B.2.8	2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type RO-DM SERVICE TRANSFORMER (0DJT01 & 0DJT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:3000(L) x2115(B) x3100(H) Weight of Shipment:8000kg approx each.	2	SET
B.2.9	2 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type TURBINE SERVICE TRANSFORMER (1DBT01 & 1DBT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:7000kg approx each.	2	SET
B.2.10	1.6 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type ESP SERVICE TRANSFORMER (1DCT01, 1DDT01, 1DET01, 1DFT01, 1DST01), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:6600kg approx each.	5	SET
B.2.11	1.6 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type DESALINATION/FW SERVICE TRANSFORMER (0DDT01 & 0DDT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:6600kg approx each.	2	SET
B.2.12	1.6 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type WORKSHOP SERVICE TRANSFORMER (0DET01 & 0DET02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:6600kg approx each.	2	SET
B.2.13	1.6 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type SEA WATER INTAKE SERVICE TRANSFORMER (0DGT01 & 0DGT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:6600kg approx each.	2	SET
B.2.14	0.63 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type FUEL OIL SERVICE TRANSFORMER (0DCT01 & 0DCT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2500(L) x1715(B) x2700(H) Weight of Shipment:3600kg approx each.	2	SET
	Note: All the Dry type service transformers along with parts and accessories are unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting.		
C	**BHEL-RUDRAPUR SCOPE OF SUPPLY**		
C.1.0	**IPBD**		
C.1.1	24 KV IP Busduct along with support structures, SPVT, PT cubicle, NG cubicle and other loose supplied items such as Seal off bushings, Rubber bellows, Earthing, Flexible connections, CTs, Lightning arrestor, Hot Air Blowing (HAB) equipment, flexible hoses from HAB	1	SET

	system to bus duct, control cabinet for HAB, Air Pressurization Equipment (APE), APE Piping, Conduiting and wiring for space heaters, illumination, Aluminium welding etc., CT/PT wiring and conduiting, erection of JBs etc. comprising of the following: a) 25000 A IP Bus duct from 660 MW Generator to 3 x 275 MVA Single phase generator transformers. b) 25000 A common tap off Bus duct. c) 14500 A Delta Run Bus duct. d) 4100 A Common Tap off bus ducts. e) 2250 A Tap off bus ducts to Unit Transformer and Station Transformer; **Dimensions and Weights:** a) BD Main run - 222 mtr weight approx 500 kg/mtr; b) BD Delta run - 129 mtr weight approx 350 kg/ mtr; c)Tapoff run - 123 mtr weight approx 250 kg/ mtr; **Conductor :** Main run size - 930 mm OD/ 15mm thick , Delta run 500 mm O/D 15 mm thick, Tap off - 2 x 203.2 x 65 x 11.84 mm (Channel Box). **Bus duct :** Main run size - 1600 mm OD/ 8 mm thick (500 kg/mtr) , Delta run 1200 mm O/D 6.35 mm thick (350 kg/mtr), Tap off - 780 mm O/D 4.78 thick (250 kg/mtr); **Bus Duct CT :** AS PER ATTACHED SLD Drg. No. 21791720004; **Hot Air Blowing Equipment with piping and pipe support** :- 1 set of dimension 1600mm (W) x2600mm(D)x3100mm(H); Wt. 2000 kg (app) having 10 HP Motor and heater capacity 36 kW; **Air pressuring equipment** :- 1 set of 200 m3/hr with compressor and receiver, drier, pressurizing panel & Electrical control panel (240 V, 50 Hz); **NG Cubicle with NGT & NGR with marshalling box, space heaters and accessories** :- 1 set of dimension 2200 (W) x 1650 (D)x1700mm(H) and wt.1600 kg (approx.); **SPPT cubicle with Surge Capacitor, Voltage Transformer with marshalling box, space heaters and accessories** :- SPPT cubicle with Surge Capacitor, Voltage Transformer with marshalling box, space heaters and accessories :- 1 set 800(W) x 2550(D) x 2000 mm (H) of wt. 1200 kg/set (total for 3 set: 3600 kg); **LAPT cubicle with Lightening Arrestor, Surge Monitor, Voltage Transformer with marshalling box, space heaters and accessories** :- LAVT cubicle with Lightening Arrestor, Surge Monitor, Voltage Transformer with marshalling box, space heaters and accessories :- 1 set 800(W) x 1500(D) x 1700 mm (H) of wt. 1000 kg/set; Weight of support Structure for IPBD: 60 MT(Approx.)		
C.2.0	**SPBD**		
C.2.1	**11 kV-4000 A SPBD BUSDUCT, SIZE - 3.15tk x 500 mm (height) x 1500 mm (width) x 3720 mm (length) for standard size, approx weight 150 kg/mtr, Conductor size - Channel Box (2 x 177.8 x 58.4 x 9.98 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**		
C.2.1.1	BD-1 INCOMER FROM UT-1A T0 11kV UNIT SWBD-1BA (PANEL No. - 01)	77	Mtrs
C.2.1.2	BD-2 INCOMER FROM UT-1B T0 11kV UNIT SWBD-1BB (PANEL No. - 20)	92	Mtrs
C.2.1.3	BD-9 INCOMER FROM ST-1 11kV STATION SWBD-0BA (PANEL No. - 16)	77	Mtrs

C.2.2	**11 kV-3150 A SPBD BUSDUCT, SIZE - 3.15tk x 450 mm (height) x 1350 mm (width) x 3720 mm (length) for standard size, approx weight 125 kg/mtr, Conductor size - Channel Box (2 x 127 x 47.8 x 8 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**		
C.2.2.1	BD-11 INCOMER FROM SBT, LV-1 TO 11kV STATION SWBD-0BD (PANEL No. - 19)	78	Mtrs
C.2.2.2	BD-12 INCOMER FROM SBT, LV-2 TO 11kV STATION SWBD-0BC (PANEL No. - 01)	73	Mtrs
C.2.2.3	BD-16 TIE FEEDER FROM 11KV STANDBY SWBD-0BD (PANEL No. - 12) TO 11kV UNIT SWBD-1BB (PANEL No. - 13)	24	Mtrs
C.2.2.4	BD-17 TIE FEEDER FROM 11KV STANDBY SWBD-0BC (PANEL No. - 06) TO 11kV UNIT SWBD-1BA (PANEL No. - 06)	13	Mtrs
C.2.2.5	BD-18 TIE FEEDER FROM 11KV STANDBY SWBD-0BC (PANEL No. - 03) TO 11kV STATION SWBD-0BA (PANEL No. - 14)	11	Mtrs
C.2.2.6	BD-22 TIE FEEDER FROM 11KV STANDBY SWBD-0BD (PANEL No. - 08) TO 11kV STATION SWBD-0BA (PANEL No. - 05)	13	Mtrs
C.2.2.7	BD-23 TIE FEEDER FROM 11KV STANDBY SWBD-0BC (PANEL No. - 17) TO 11kV UNIT SWBD-1BB (PANEL No. - 04)	21	Mtrs
C.2.2.8	BD-24 TIE FEEDER FROM 11KV STANDBY SWBD-0BD (PANEL No. - 03) TO 11kV UNIT SWBD-1BA (PANEL No. - 19)	18	Mtrs
C.2.3	**6.6 kV-1600 A SPBD BUSDUCT, SIZE - 3.15tk x 400 mm (height) x 1200 mm (width) x 3720 mm (length) for standard size, approx weight 100 kg/mtr, Conductor size - Channel Box (2 x 101.6 x 41.8 x 6.68 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**		
C.2.3.1	BD-5 INCOMER FROM UAT-1CAT01 T0 6.6kV UNIT AUX. SWBD-1CA (PANEL No. - 11)	68	Mtrs
C.2.3.2	BD-6 INCOMER FROM UAT-1CAT02 T0 6.6kV UNIT AUX. SWBD-1CA (PANEL No. - 20)	67	Mtrs
C.2.4	**2 sets of 6.6 kV-630 A (SAT/COMPRESSOR HOUSE) SPBD BUSDUCT, SIZE - 3.15tk x 400 mm (height) x 1200 mm (width) x 3720 mm (length) for standard size, approx weight 80 kg/mtr, Conductor size - Channel (1 x 101.6 x 41.8 x 6.68 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**	34	Mtrs
C.2.5	**2 sets of 6.6 kV-1250 A (AHP AUXILIARY TRANSFORMER) SPBD BUSDUCT, SIZE - 3.15tk x 400 mm (height) x 1200 mm (width) x 3720 mm (length) for standard size, approx weight 80 kg/mtr, Conductor size - Channel (1 x 101.6 x 41.8 x 6.68 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**	21	Mtrs
C.2.6	**2 sets of 6.6 kV-3500 A (Sea Water AUXILIARY TRANSFORMER) SPBD BUSDUCT, SIZE - 3.15tk x 500 mm (height) x 1500 mm (width) x 3720 mm (length) for standard size, approx weight 140 kg/mtr, Conductor size - Channel (2 x 152.4 x 51.6 x 8.1 tk) mm**	27	Mtrs

	and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.		
C.2.7	**2 sets of 6.6 kV-630 A (RO-DM) SPBD BUSDUCT, SIZE - 3.15tk x 400 mm (height) x 1200 mm (width) x 3720 mm (length) for standard size, approx weight 80 kg/mtr, Conductor size - Channel (1 x 101.6 x 41.8 x 6.68 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**	23	Mtrs
D	**SCOPE OF SUPPLY FROM PEM**		
D.1	**11 KV XLPE (AL) ARMOURED CABLE**		
D.1.1	1C x 630 sqmm (AL)	34500	Mtrs
D.1.2	1C x 300 sqmm (AL)	15000	Mtrs
D.1.3	3C x 240 sqmm (AL)	7750	Mtrs
D.2	**6.6 KV XLPE (AL) ARMOURED CABLE**		
D.2.1	1C x 630 sqmm (AL)	14500	Mtrs
D.2.2	3C x 150 sqmm (AL)	10750	Mtrs
D.3	**Cable termination kits for 11/11 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
D.3.1	Termination KIT 11KV 1C-630 sqmm AL ARM (indoor) AL LUG	46	Nos.
D.3.2	Termination KIT 11KV 1C-300 sqmm AL ARM (indoor) AL LUG	124	Nos.
D.3.3	Termination KIT 11KV 3C-240 sqmm AL ARM (indoor) AL LUG	40	Nos.
D.4	**Cable straight through joint kits for 11/11 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
D.4.1	Joint kit 11 KV 1C-630 sqmm AL ARM (indoor) AL LUG	48	Nos.
D.4.2	Joint kit 11 KV 1C-300 sqmm AL ARM (indoor) AL LUG	19	Nos.
D.4.3	Joint kit 11 KV 3C-240 sqmm AL ARM (indoor) AL LUG	8	Nos.
D.5	**Cable termination kits for 6.6 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
D.5.1	Termination KIT 6.6 KV 1C-630 sqmm AL ARM (indoor) AL LUG	22	Nos.
D.5.2	Termination KIT 6.6 KV 3C-150 sqmm AL ARM (indoor) AL LUG	78	Nos.
D.6	**Cable stright through joint kits for 6.6 / 6.6 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
D.6.1	Joint Kit 6.6 KV 3C-150 sqmm AL ARM (indoor) AL LUG	7	Nos.
D.7	**Hot Dip Galvanised Steel Flats (to be supplied in length of minimum 6 metres) & Other Earthing materials**		
D.7.1	GS FLAT 65 X 8 mm	3300	Mtrs
D.7.2	GS FLAT 50 X 6 mm	2750	Mtrs
D.7.3	GS FLAT 25 X 6 mm	1125	Mtrs
D.7.4	GS FLAT 25 X 3 mm	330	Mtrs
D.7.5	GI WIRE 14 SWG	1700	Mtrs
D.7.6	Flexible braided copper conductor with copper clamp for gate earthing	8	Nos.

D.7.7	Treated Earth pit of Galvanised MS pipe of 65 mm Dia, 3000 mm long perforated with clamp, funnel and accessories including all civil works, filling of earth pit of size min 400x400x3000 mm with alternate layer of charcoal & salt as per IE specification and making of brick chamber, with both side plastering, supply and fixing of manhole with CI cover plate/RCC Slab etc. complete as per IS 3043 (only 3000 mm long, 65 NB Galvanized MS pipe shall be supplied by BHEL; All other accessories as mentioned above are in vendor's scope)	56	SET
D.7.8	11 kV Neutral Ground Resistor (NGR) with NGR Cubicle of size 1200x1350x950 of weight app. 495 kg and with Galvanized Supporting Structures	4	SET
D.7.9	6.6 kV Neutral Ground Resistor (NGR) with NGR Cubicle of size 1000x900x800 of weight app. 290 kg and with Galvanized Supporting Structures.	6	SET
D.8	**Generator Circuit Breaker and accessories**		
D.8.1	Generator circuit breaker (GCB) below generator Rating 27000 A, 21 kV size app. 6751mm x 4000 mm x 3535 mm along with centralizing cubicle and overall weight - 10288 kg.	1	SET
D.9.	**Commissioning of the following erected by Mechanical contractor**		
D.9.1	Generator 660 MW - H.V. testing, meggering of Bushings & Accessories, resistance measurement, meggering including dry out of Generator and as per field quality plan.	1	SET
D.9.2	Exciter dryer / heater	1	No.
D.9.3	Generator Air Drier	1	No.
D.9.4	CO_2 Vaporizer	1	No.
D.9.5	Exciter Stroboscope	1	No.
D.9.6	11 KV HT drives - ID/FD/PA - each 2 Nos, MDBFP - 1 No, CW pump-3 Nos.	10	Nos.
D.9.7	6.6 KV HT motor - MILLS-7, CEP- 3, ACW-2, ECW-TG-3,BCW - 1	16	Nos.
D.9.8	6.6 KV HT motor - Other Applications	40	Nos.
D.10	**MV Transformers**		
D.10.1	6.3 MVA, 11/6.9 kV, 3 phase, ONAN/DyN1, RO-DM AUXILIARY TRANSFORMER (0CET01 & 0CET02), Outdoor with HV/LV/LVN Marshalling Box 800(L)x200(B)x800(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, Overall Dimension: 4200(L)x2600(B)x3250(H); Shipping Dimension of Largest package:3800(L) x2150(B) x1950(H) Weight of heaviest package - 8700kg approx. Total Weight - 10600 kg approx; Insulating Oil Qty - 1900kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting	2	SET

D.10.2	5 MVA, 11/6.9 kV, 3 phase, ONAN/DyN1, STATION AUXILIARY TRANSFORMER (0CAT01 & 0CAT02), Outdoor with HV/LV/LVN Marshalling Box 800(L)x200(B)x800(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, Overall Dimension: 4200(L)x2600(B)x3250(H); Shipping Dimension of Largest package:3800(L) x2150(B) x1950(H) Weight of heaviest package - 8700 kg approx. Total Weight - 10600 kg approx; Insulating Oil Qty - 1900 kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting	2	SET
D.11	**STRUCTURAL SUPPORTS (OTHER THAN BUS DUCTS STRUCTURALS)**		
D.11.1	ISA 50X50X6	15	MT
D.11.2	ISA 65X65X6	2	MT
D.11.3	ISMC 100	20	MT
D.11.4	ISMC 150	10	MT
E	**BHEL EDN SCOPE OF SUPPLY**		
E.1	Digital AVR consisting of 2No. Regulation cubicle, 1 No. Thyristor cubicle & 1 No. Field suppression cubicle, and associated loose supplied items including laying & termination of loose supplied power &control cables for DAVR system. DAVR Overall dimension: 4053 (L)x 800 (Wx 2465(H) mm Approximate wt. : 3000 Kg. * Lump sum rate to be quoted.	1	SET
E.2	3C x 50 sqmm copper (Excitation + power input)	800	Mtrs
E.3	End Termination 3C x 50 sqmm copper (Excitation + power input)	16	Nos.
E.4	1Cx 70 sqmm copper (earthing)	100	Mtrs
E.5	End Termination 1Cx 70 sqmm copper (earthing)	4	Nos.
E.6	Unit Control Panel(UCP)- approx panel size 2216(L) x1000(W) x 2355(H) approx weight 900 kg	1	No.
E.7	Unit Electrical Control Panel(UECP)- approx panel size 2792 (L)x 1000(W) x 2355(H) , approx weight 900 kg	1	No.
E.8	EDMS (CYJ-01) electrical interface system panel size 750(L) x750(W) x 2067(H) approx weight 400 kg	1	No.
E.9	IEMS (CYJ-02) electrical interface system panel size 750(L) x750(W) x 2067(H) approx weight 400 kg	1	No.
E.11	EDMS HMI system consists of Server computer with monitor qty 2 nos and Engineering cum Operator Work Station (E-OWS) with monitor - 1 No., Operator Work Station (OWS) with monitor - 1 No. A3 Multi-Function Printer - 1 no & UTP cable - 300 mtrs	1	SET
E.12	IEMS HMI system consists of Server computer with monitor qty 2 nos and Engineering cum Operator Work Station (E-OWS) with monitor -	1	SET

	1 No., Operator Work Station (OWS) with monitor - 2 Nos. A4 Color Laser Printer - 1 no & UTP cable - 300 mtrs		
F	**ERECTION OF MISCELLANEOUS ITEMS**		
F.1	Earthing with MS earth rod 40 mm (Below ground earthing system)	150	Mtrs
G	**BHEL-TBG SCOPE OF SUPPLY**		
G.1	19/33 kV XLPE AL, PVC INSULATED 1CX400 SQMM ARMOURED AL CABLES	700	Mtrs
G.2	Cable Termination Kit for 1C x 400 Sq. mm., 19/33kV(E) , Stranded Circular and compacted Aluminium Conductor, XLPE insulated, Armoured, FRLS PVC outer sheath Power Cable	28	Nos.

1.9.2 BOQ of Package-2

Sl.No.	DESCRIPTION	QTY	UOM
H	**BHEL-BHOPAL SCOPE OF SUPPLY**		
H.1	**HV TRANSFORMERS**		
H.1.1	275/220/165 MVA,(420/√3)/21 kV, 1 phase, OFAF/ONAF/ONAN cooled,YNd11 (after 3 phase bank), Generator Transformer (GT#1), Outdoor with Off Circuit tap changers (OCTC),HV/HVN/LV bushings, post insulators, neutral bushings, bushing CTs, Turrets, Conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories. Approximate Dimensions of each transformer (l x b x h): Overall Dimensions: 11765(L) x7535(B) x9790(H). Shipping Dimension of Largest package:6200(L) x4700(B) x4710(H). Weight of heaviest package - 203000kg approx. Weight of core and winding assembly-175000kg approx.; Weight of tank cover, tank, Radiators, A frame and fittings–50600 kg approx.; Total weight of the package including oil-296100 kg approx.; Insulating Oil Qty - 54000 kg.approx.* Please refer TCC for scope and other details. Only Tanks of all the four GTs are unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the GT Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting.	3	SET
H.2	**11 kV SWITCHGEAR**		
H.2.1	Unit Switchboard 2BA - 11KV, indoor panel, metal clad, vacuum break switch gears of 4000 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 22 panels of suitable 12 shipping sections. Over all panel sizes- 18220 (L) x 2927(D)X2805 (H) Weight of shipping for 1 panel - 1250 Kg(820mm	1	SET

	wide) approx. for shipping two panel - 2500 Kg approx.(820mm + 820mm wide)		
H.2.2	Unit Switchboard 2BB - 11KV, indoor panel, metal clad, vacuum break switch gears of 4000 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 21 panels of suitable 11 shipping sections. Over all panel sizes- 17400 (L) x 2927 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx.& for two panel - 2500 kg (820mm + 820mm).	1	SET
H.3	**6.6 kV SWITCHGEAR**		
H.3.1	Unit Auxiliary Switchboard 2CA - 6.6 KV, indoor panel, metal clad, vacuum break switch gears of 1250 A incomer- outgoing feeders BUS PT cubicle along with associated loose supplied items consists of 27 panels of suitable 15 shipping sections. Over all panel sizes- 21920 (L) x 2833 (D) x2805(H) Weight of shipping for 1 panel - 1250 Kg(820mm wide) approx. for shipping two panel - 2500 Kg approx.(820 + 820mm wide)	1	SET
H.4	**INTERMEDIATE/SUPPORTING SWITCHGEARS & ACCESSORIES**		
H.4.1	Fast Bus Transfer System Panels for 11 KV SWGR size 800 (w) x 800 (d) x 2295 (h) weight 300 kg approx, along with accessories computers, printers, table, checking of pre-assembled LIUs, communication cables etc. (2BA to 0BF & 2BB to 0BF)	2	SET
H.4.2	Protection panel for Generator/GT/UT/ST with associated loose supplied items such as Laptop, PC, Printer, UPS, interconnecting cables, RJ45 cables etc. Size of the Panel: 800 (W) x800 (D) x 2295 (H) mm Approximate weight of the panel : 450 kg. Lump sum rate to be quoted.	8	SET
H.4.3	Data concentrator panel-2 for Unit-2 SWBD (11 kV Unit 1 & Station SWBD) at control room along with loose items size 800mm(W) x800mm(D) x 2000mm(H) approx weight 200kg	1	SET
H.4.4	11 kV -4000 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	2	Nos.
H.4.5	11 kV -2500 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	1	Nos.
H.4.6	6.6 kV - 2500 A Earthing Breaker Trucks for Feeder/Busbar, size 650 mm x 861mm x 1363 mm approx weight 500 kg	2	Nos.
H.4.7	OFC cable includes fixing of fibre optic components and termination kits LIU, face plates, cabinets, SC coupler, grounding etc	11000	Mtrs
H.4.8	OFC Splicing	75	Nos.
H.4.9	D link 4 pair PVC, CAT 5e LAN cable	6000	Mtrs
I	**VOID**		
J	**BHEL-JHANSI SCOPE OF SUPPLY**		
J.1.0	**HV TRANSFORMERS**		
J.1.1	56/70 MVA, 21 KV/11.5KV, 3 Phase, ONAN/ONAF cooled, Dyn1, Station Transformer(ST) Outdoor with On Load Tap Changers	1	SET

	(OLTC) HV/LV/LVN post insulators, neutral bushings, bushing CTs, Turrets, conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories, etc. Approximate Dimensions of transformer (LxBxH) : Overall Dimensions: 9794(L) x7200(B) x6950(H) approx. Shipping Dimension of Largest package :3950(L) x2200(B) x5384(H) approx. Weight of heaviest package - 50000kg approx. Weight of core and winding assembly- 37000kg, weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers –28000kg approx.; Total weight of the package-86500kg approx.; Insulating Oil Qty - 28000 kg.approx.* Please refer TCC for scope and other details. Only Tank of this Transformer is unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting		
J.1.2	56/70 MVA, 21 KV/11.5KV, 3 Phase, ONAN/ONAF cooled, Dyn1, Unit Transformer(UT) Outdoor with On Load Tap Changers (OLTC) HV/LV/LVN post insulators, neutral bushings, bushing CTs, Turrets, conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories, etc. Approximate Dimensions of transformer (LxBxH) : Overall Dimensions: 9794(L) x7200(B) x6950(H) approx. Shipping Dimension of Largest package :3950(L) x2200(B) x5384(H) approx. Weight of heaviest package - 50000kg approx. Weight of core and winding assembly- 37000kg, weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers –28000kg approx.; Total weight of the package-86500kg approx.; Insulating Oil Qty - 28000 kg.approx.* Please refer TCC for scope and other details. Only Tank of this Transformer is unloaded in the rail of the transformer yard and are to be dragged into their foundation. Lump sum rate to be quoted for Dragging the Tanks to their respective foundations, transportation of other parts of transformers from Storage Yard (approximately 2 km) to the foundation, Erection, Testing, Commissioning of the complete system including final painting	2	SET
J.2.0	**MV Transformers**		
J.2.1	12.5 MVA, 11/6.9 kV, 3 phase, ONAN/Dyn1, UNIT AUXILIARY TRANSFORMER (UAT) (2CAT01 & 2CAT02), Outdoor with HV/LV/LVN Marshalling Box (1150(L)x465(B)x1415(H)) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , HV, LV bushings, a. Overall Dimensions: 7000(L) x5000(B) x6000(H) b. Shipping Dimension of Largest	2	SET

	package:4400(L) x2500(B) x2900(H) Weight of heaviest package - 27000kg approx. Total Weight - 45000kg approx;Insulating Oil Qty - 11100kg approx.* This transformer along with its parts and accessories is unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting		
J.2.2	2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type BOILER SERVICE TRANSFORMER (2DAT01 & 2DAT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:3000(L) x2115(B) x3100(H) Weight of Shipment:8000kg approx each.	2	SET
J.2.3	2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type STATION SERVICE TRANSFORMER (0DBT01 & 0DBT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:3000(L) x2115(B) x3100(H) Weight of Shipment:8000kg approx each.	2	SET
J.2.4	2 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type TURBINE SERVICE TRANSFORMER (2DBT01 & 2DBT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:7000kg approx each.	2	SET
J.2.5	2 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type ELECTRO-CHLORINATION SERVICE TRANSFORMER (0DHT01 & 0DHT02), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:7000kg approx each.	2	SET
J.2.6	1.6 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type ESP SERVICE TRANSFORMER (2DCT01, 2DDT01, 2DET01, 2DFT01, 2DST01), Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box; Approximate Shipping Dimensions:2800(L) x1965(B) x2950(H) Weight of Shipment:6600kg approx each.	5	SET
	Note: All the Dry type service transformers along with parts and accessories are unloaded in the Storage Yard which approximately 2 km from the foundation. Lump sum rate to be quoted for transportation from the storage yard up to the foundation, Erection, Testing Commissioning including final painting.		
K	**BHEL-RUDRAPUR SCOPE OF SUPPLY**		
K.1.0	**IPBD**		
K.1.1	24 KV IP Busduct along with support structures, SPVT, PT cubicle, NG cubicle and other loose supplied items such as Seal off bushings, Rubber bellows, Earthing, Flexible connections, CTs, Lightning arrestor, Hot Air Blowing (HAB) equipment, flexible hoses from HAB system to bus duct, control cabinet for HAB, Air Pressurization Equipment (APE), APE Piping, Conduiting and wiring for space heaters, illumination, Aluminium welding etc., CT/PT wiring and	1	SET

	conduiting, erection of JBs etc. comprising of the following: a) 25000 A IP Bus duct from 660 MW Generator to 3 x 275 MVA Single phase generator transformers. b) 25000 A common tap off Bus duct. c) 14500 A Delta Run Bus duct. d) 4100 A Common Tap off bus ducts. e) 2250 A Tap off bus ducts to Unit Transformer and Station Transformer; **Dimensions and Weights:** a) BD Main run - 222 mtr weight approx 500 kg/mtr; b) BD Delta run - 129 mtr weight approx 350 kg/ mtr; c)Tapoff run - 123 mtr weight approx 250 kg/ mtr; **Conductor :** Main run size - 930 mm OD/ 15mm thick , Delta run 500 mm O/D 15 mm thick, Tap off - 2 x 203.2 x 65 x 11.84 mm (Channel Box). **Bus duct :** Main run size - 1600 mm OD/ 8 mm thick (500 kg/mtr) , Delta run 1200 mm O/D 6.35 mm thick (350 kg/mtr), Tap off - 780 mm O/D 4.78 thick (250 kg/mtr); **Bus Duct CT :** AS PER ATTACHED SLD Drg. No. 21791720004; **Hot Air Blowing Equipment with piping and pipe support** :- 1 set of dimension 1600mm (W) x2600mm(D)x3100mm(H); Wt. 2000 kg (app) having 10 HP Motor and heater capacity 36 kW; **Air pressuring equipment** :- 1 set of 200 m3/hr with compressor and receiver, drier, pressurizing panel & Electrical control panel (240 V, 50 Hz); **NG Cubicle with NGT & NGR with marshalling box, space heaters and accessories** :- 1 set of dimension 2200 (W) x 1650 (D)x1700mm(H) and wt.1600 kg (approx.); **SPPT cubicle with Surge Capacitor, Voltage Transformer with marshalling box, space heaters and accessories** :- SPPT cubicle with Surge Capacitor, Voltage Transformer with marshalling box, space heaters and accessories :- 1 set 800(W) x 2550(D) x 2000 mm (H) of wt. 1200 kg/set (total for 3 set: 3600 kg); **LAPT cubicle with Lightening Arrestor, Surge Monitor, Voltage Transformer with marshalling box, space heaters and accessories** :- LAVT cubicle with Lightening Arrestor, Surge Monitor, Voltage Transformer with marshalling box, space heaters and accessories :- 1 set 800(W) x 1500(D) x 1700 mm (H) of wt. 1000 kg/set; Weight of support Structure for IPBD: 60 MT(Approx.)		
K.2.0	**SPBD**		
K.2.1	**11 kV-4000 A SPBD BUSDUCT, SIZE - 3.15tk x 500 mm (height) x 1500 mm (width) x 3720 mm (length) for standard size, approx weight 150 kg/mtr, Conductor size - Channel Box (2 x 177.8 x 58.4 x 9.98 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**		
K.2.1.1	BD-3 INCOMER FROM UT-2A T0 11kV UNIT SWBD-2BA (PANEL No. - 01)	151	Mtrs
K.2.1.2	BD-4 INCOMER FROM UT-2B T0 11kV UNIT SWBD-2BB (PANEL No. - 20)	132	Mtrs
K.2.1.3	BD-10 INCOMER FROM ST-2 11kV STATION SWBD-0BB (PANEL No. - 01)	131	Mtrs
K.2.2	**11 kV-3150 A SPBD BUSDUCT, SIZE - 3.15tk x 450 mm (height) x 1350 mm (width) x 3720 mm (length) for standard size, approx weight 125 kg/mtr, Conductor size - Channel Box (2 x 127 x 47.8**		

	x 8 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.		
K.2.2.1	BD-13 TIE FEEDER FROM 11KV UNIT SWBD-2BA (PANEL No. - 10) TO 11kV STANDBY SWBD-0BC (PANEL No. - 10)	24	Mtrs
K.2.2.2	BD-14 TIE FEEDER FROM 11KV UNIT SWBD-2BB (PANEL No. - 15) TO 11kV STANDBY SWBD-0BD (PANEL No. - 14)	13	Mtrs
K.2.2.3	BD-15 TIE FEEDER FROM 11KV STATION SWBD-0BB (PANEL No. - 03) TO 11kV STANDBY SWBD-0BD (PANEL No. - 17)	11	Mtrs
K.2.2.4	BD-19 TIE FEEDER FROM 11KV UNIT SWBD-2BA (PANEL No. - 12) TO 11kV STANDBY SWBD-0BD (PANEL No. - 01)	27	Mtrs
K.2.2.5	BD-20 TIE FEEDER FROM 11KV UNIT SWBD-2BB (PANEL No. - 01) TO 11kV STANDBY SWBD-0BC (PANEL No. - 21)	29	Mtrs
K.2.2.6	BD-21 TIE FEEDER FROM 11KV STATION SWBD-0BB (PANEL No. - 15) TO 11kV STANDBY SWBD-0BC (PANEL No. - 15)	13	Mtrs
K.2.3	**6.6 kV-1600 A SPBD BUSDUCT, SIZE - 3.15tk x 400 mm (height) x 1200 mm (width) x 3720 mm (length) for standard size, approx weight 100 kg/mtr, Conductor size - Channel Box (2 x 101.6 x 41.8 x 6.68 tk) mm and includes seal off bushing, rubber bellows, support steel structure, space heaters, grounding.**		
K.2.3.1	BD-7 INCOMER FROM UAT-2CAT01 T0 6.6kV UNIT AUX. SWBD-2CA (PANEL No. - 08)	57	Mtrs
K.2.3.2	BD-8 INCOMER FROM UAT-2CAT02 T0 6.6kV UNIT AUX. SWBD-2CA (PANEL No. - 17)	61	Mtrs
L	**SCOPE OF SUPPLY FROM PEM**		
L.1	**11 KV XLPE (AL) ARMOURED CABLE**		
L.1.1	1C x 630 sqmm (AL)	34500	Mtrs
L.1.2	1C x 300 sqmm (AL)	15000	Mtrs
L.1.3	3C x 240 sqmm (AL)	7750	Mtrs
L.2	**6.6 KV XLPE (AL) ARMOURED CABLE**		
L.2.1	1C x 630 sqmm (AL)	14500	Mtrs
L.2.2	3C x 150 sqmm (AL)	10750	Mtrs
L.3	**Cable termination kits for 11/11 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
L.3.1	Termination KIT 11KV 1C-630 sqmm AL ARM (indoor) AL LUG	44	Nos.
L.3.2	Termination KIT 11KV 1C-300 sqmm AL ARM (indoor) AL LUG	124	Nos.
L.3.3	Termination KIT 11KV 3C-240 sqmm AL ARM (indoor) AL LUG	38	Nos.
L.4	**Cable stright through joint kits for 11/11 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
L.4.1	Joint kit 11 KV 1C-630 sqmm AL ARM (indoor) AL LUG	48	Nos.
L.4.2	Joint kit 11 KV 1C-300 sqmm AL ARM (indoor) AL LUG	18	Nos.
L.4.3	Joint kit 11 KV 3C-240 sqmm AL ARM (indoor) AL LUG	8	Nos.

L.5	**Cable termination kits for 6.6 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
L.5.1	Termination KIT 6.6 KV 1C-630 sqmm AL ARM (indoor) AL LUG	20	Nos.
L.5.2	Termination KIT 6.6 KV 3C-150 sqmm AL ARM (indoor) AL LUG	78	Nos.
L.6	**Cable stright through joint kits for 6.6 / 6.6 KV (UE) GRADE, XLPE Insulated aluminium conductor armoured cables for the following sizes.**		
L.6.1	Joint Kit 6.6 KV 3C-150 sqmm AL ARM (indoor) AL LUG	6	Nos.
L.7	**Hot Dip galvanized Steel Flats (to be supplied in length of minimum 6 metres) & Other Earthing materials**		
L.7.1	GS FLAT 65 X 8 mm	3300	Mtrs
L.7.2	GS FLAT 50 X 6 mm	2750	Mtrs
L.7.3	GS FLAT 25 X 6 mm	1125	Mtrs
L.7.4	GS FLAT 25 X 3 mm	330	Mtrs
L.7.5	GI WIRE 14 SWG	1700	Mtrs
L.7.6	Flexible braided copper conductor with copper clamp for gate earthing	7	Nos.
L.7.7	Treated Earth pit of Galvanized MS pipe of 65 mm Dia, 3000 mm long perforated with clamp, funnel and accessories including all civil works, filling of earth pit of size min 400x400x3000 mm with alternate layer of charcoal & salt as per IE specification and making of brick chamber, with both side plastering, supply and fixing of manhole with CI cover plate/RCC Slab etc. complete as per IS 3043 (only 3000 mm long, 65 NB Galvanized MS pipe shall be supplied by BHEL; All other accessories as mentioned above are in vendor's scope)	56	SET
L.7.8	11 kV Neutral Ground Resistor (NGR) with NGR Cubicle of size 1200x1350x950 of weight app. 495 kg and with Galvanized Supporting Structures	4	SET
L.7.9	6.6 kV Neutral Ground Resistor (NGR) with NGR Cubicle of size 1000x900x800 of weight app. 290 kg and with Galvanized Supporting Structures.	6	SET
L.8	**Generator Circuit Breaker and accessories**		
L.8.1	Generator circuit breaker (GCB) below generator Rating 27000 A, 21 kV size app. 6751mm x 4000 mm x 3535 mm along with centralizing cubicle and overall weight - 10288 kg.	1	SET
L.9.	**Commissioning of the following erected by Mechanical contractor**		
L.9.1	Generator 660 MW - H.V. testing, meggering of Bushings & Accessories, resistance measurement, meggering including dry out of Generator and as per field quality plan.	1	SET
L.9.2	Exciter dryer / heater	1	No.
L.9.3	Generator Air Drier	1	No.
L.9.4	CO_2 Vaporizer	1	No.
L.9.5	Exciter Stroboscope	1	No.
L.9.6	11 KV HT drives - ID/FD/PA - each 2 nos, MDBFP - 1 No, CW pump-3 Nos.	10	Nos.
L.9.7	6.6 KV HT motor - MILLS-7, CEP- 3, ACW-2, ECW-TG-3,BCW – 1	16	Nos.

L.9.8	6.6 KV HT motor - Other Applications	22	Nos.
L.11	**STRUCTURAL SUPPORTS (OTHER THAN BUSDUCT STRUCTURALS)**		
L.11.1	ISA 50X50X6	15	MT
L.11.2	ISA 65X65X6	2	MT
L.11.3	ISMC 100	20	MT
L.11.4	ISMC 150	10	MT
M	**BHEL EDN SCOPE OF SUPPLY**		
M.1	Digital AVR consisting of 2No. Regulation cubicle, 1 No. Thyristor cubicle & 1 No. Field suppression cubicle, and associated loose supplied items including laying & termination of loose supplied power &control cables for DAVR system. DAVR Overall dimension: 4053 (L)x 800 (Wx 2465(H) mm Approximate wt. : 3000 Kg. * Lump sum rate to be quoted.	1	SET
M.2	3C x 50 sqmm copper (Excitation + power input)	800	Mtrs
M.3	End Termination 3C x 50 sqmm copper (Excitation + power input)	16	Nos.
M.4	1Cx 70 sqmm copper (earthing)	100	Mtrs
M.5	End Termination 1Cx 70 sqmm copper (earthing)	4	Nos.
M.6	Unit Control Panel(UCP)- approx panel size 2216(L) x1000(W) x 2355(H) approx weight 900 kg	1	No.
M.7	Unit Electrical Control Panel(UECP)- approx panel size 2792 (L)x 1000(W) x 2355(H) , approx weight 900 kg	1	No.
M.10	EDMS (CYJ-03) electrical interface system panel size 750(L) x750(W) x 2067(H) approx weight 400 kg	1	No.
M.11	EDMS HMI system consists of Server computer with monitor qty 2 nos and Engineering cum Operator Work Station (E-OWS) with monitor - 1 No., Operator Work Station (OWS) with monitor - 1 No. A3 Multi-Function Printer - 1 no & UTP cable - 300 mtrs	1	SET
N	**ERECTION OF MISCELLANEOUS ITEMS**		
N.1	Earthing with MS earth rod 40 mm (Below ground earthing system)	150	Mtrs

VOLUME-IA PART –I CHAPTER –X

GENERAL

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

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

1.10

a. **Bidders are requested to furnish the following at PSSR-HQ, Chennai immediately after release of Letter of Intent (LOI)**

I. Security Deposit.

II. Unqualified Acceptance for Detailed LOI/ Work Order.

III. Rs.100/- Stamp Paper for preparation of Contract Agreement.

b. **Bidders are requested to furnish the proof of documents for the following at PSSR- Site.**

I. PF Regn No.

II. Labour License No.

III. Workmen Insurance Policy No.

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

1.10.1.1 BOCW Act & BOCW Welfare Cess Act

i. 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.

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

iii. 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.

iv. 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.

v. 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.

vi. Non-compliance to Provisions of the BOCW Act & BOCW 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

1.10.1.2 PROVIDENT FUND

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

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

1.10.1.3 OTHER STATUTORY REQUIREMENTS

i. 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.

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

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

iv. The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen under I D Act1948, 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.

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

vi. 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.

1.10.1.4 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

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

The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training. Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 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.

1.10.2 OTHER GENERAL REQUIREMENTS:

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.

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

1.10.2.2 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.

1.10.2.3 Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc., in their possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and

skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.10.2.4 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.

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

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

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

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

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

1.10.2.10 During the course of erection, testing and commissioning certain rework / modification/ rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and/ or units under erection and commissioning and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously. Payments for such works shall be governed by Cl. No. 1.10.7.6 of TCC and Cl. No. 2.15.1 of GCC.

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

1.10.2.12 If any item or equipment not covered but requires being erected/commissioned, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ.

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

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

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

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

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

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

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

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

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

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

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

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

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

1.10.2.25 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.

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

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

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

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

1.10.2.30 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.

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

1.10.2.32 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.

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

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

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

1.10.2.36 It is the responsibility of the contractor to do the alignment, checking, etc., if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.

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

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

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

1.10.2.40 Permanent nomenclature/identification on LPBS/Junction boxes/Local Motor Starter boxes/AC Fuse DB/DC Fuse DB/Heater JB/Control panel, LT panel &

individual feeders, HT Panel & individual feeders, SP Bus duct heater JB, Transformers are to be done by the contractor as per the requirement of BHEL Engineer.

1.10.2.41 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there is no extra cost in this regard. Also refer the clause - ELECTRICAL INSPECTORATE'S APPROVAL below.

1.10.3 ELECTRICAL INSPECTORATE'S APPROVAL

1.10.3.1 Contractor is responsible for getting Electrical Inspector/statutory authority's approval for all electrical installation covered in their scope. This also includes the Electrical equipment that are erected by mechanical contractor for which commissioning assistance is to be provided by the Electrical contractor.

1.10.3.2 All electrical installation covered in contractor's scope which also includes equipment covered in commissioning assistance are to be inspected/approved by the electrical inspector/statutory authority. For getting electrical inspector approval, contractor shall arrange the following:

a. Work Completion certificate for all the equipment covered in the contract
b. Details of Equipment (specification).
c. Test results conducted at site for all the equipment including electrical equipment erected by Mechanical contractor.

Any other documents as required by statutory authority. Any expenditure related to documentation shall be borne by contractor.

1.10.3.3 Contractor shall carry out the modifications/rectifications, if any, as suggested by the authority at their cost. However, it is not applicable for equipment erected by Mechanical contractor.

1.10.3.4 Contractor shall also have valid electrical installation license on their company as well as for individuals acceptable to respective state electrical inspectorate requirement.

1.10.3.5 The contractor shall arrange necessary statutory inspections and obtain certificate for installation work at their cost. Any Expenditure related to documentation shall be borne by the contractor. Contractor shall pay all fees relates to electrical inspectorate approval. However, BHEL shall reimburse all statutory fees on production of receipts (FEES FOR VISITS, INSPECTION FEES, REGISTRATION FEES and any other statutory fees).

1.10.3.6 **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.**

1.10.4 SITE INSPECTION

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

1.10.4.2 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.

1.10.4.3 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.

1.10.4.4 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.

1.10.5 MANPOWER REQUIREMENT

1.10.5.1 Manpower requirement for Erection and Commissioning shall 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 Engineering Degree with minimum 5 years' experience or Diploma in Electrical /Electronic engineering with minimum 10 years of experience in Thermal Power Station.

c. Supervisor should have a minimum qualification of Diploma in electrical engineering or any graduate with minimum 5 years of experience in Thermal Power Station.

d. Lab Technicians should have experience in Thermal Power Stations.

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

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

g. Licensed supervisor-01 No. with valid HT electrical license

h. HT cable jointer-01 No. should be available on 24x7 basis.

i. Dedicated commissioning engineer should be deployed for commissioning of the equipment.

1.10.5.2 There shall be separate Erection In-charge for HT electrical work. He shall work with required manpower, T&P etc., including storage facilities.

1.10.5.3 Each Erection In-charge shall have minimum 3 erection engineers who shall be in charge of TRANSFORMERS, BUS DUCT, SWITCHGEAR & CONTROL PANELS AND CABLES &TRAYS.

1.10.5.4 Each area engineer shall be provided with minimum four 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 the each Unit and the minimum requirement shall be as indicated in previous Clause. Besides, there shall be separate engineers for Planning, Safety and Quality.

1.10.5.5 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.

1.10.5.6 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.

1.10.5.7 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.

1.10.5.8 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.

1.10.5.9 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.

1.10.5.10 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.

1.10.5.11 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.

1.10.6 DOCUMENTATION

1.10.6.1 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.

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

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.

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

1.10.6.3 VOLUME-IA PART- II CHAPTER -4 of this booklet contains general guidelines for Erection and Commissioning of Electrical package.

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 FOUNDATIONS, GROUTING AND CIVIL WORKS

1.11.1 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.

1.11.2 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.

1.11.3 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.

1.11.4 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.

1.11.5 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.

1.11.6 Foundation pockets are to be cleaned thoroughly before placing the equipment. Verticality of foundation bolts to be checked along with correctness of the threads

and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.

1.11.7 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.

1.11.8 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.

1.11.9 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.

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

1.11.11 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.

1.11.12 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.

1.11.13 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.

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

VOLUME-IA PART –I CHAPTER -XII

MATERIAL HANDLING, TRANSPORTATION AND SITE STORAGE

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

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

1.12.1 COLLECTION OF BHEL SCOPE OF SUPPLY MATERIALS

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

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

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

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

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

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

1.12.2 STORAGE

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

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

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

1.12.2.4 Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced 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.

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.

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

1.13	**SCOPE OF WORKS- DETAILED**
1.13.1	**TRANSFORMERS:** Different types of transformers like oil immersed or dry type shall be supplied: Refer BOQ and reference drawings for more details.
1.13.1.1	**GENERATOR TRANSFORMER:** 275/220/165 MVA, (420/√3)/21 kV, 1 phase, OFAF/ONAF/ONAN cooled, YNd11 (after 3 phase bank), Generator Transformer (GT#1), Outdoor with Off Circuit tap changers (OCTC), HV/HVN/LV bushings, post insulators, neutral bushings, bushing CTs, Turrets, Conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories. **Please refer BOQ for dimension and other details.**
1.13.1.2	**STANDBY MAINTENANCE TRANSFORMER (SBT):** 110/55/55 MVA, 400/11.5 -11.5 KV, 3 Phase, with ONAN/ONAF/OFAF cooled, YNyn0yn0, Outdoor with On Load Tap Changers (OLTC) HV/LV1 & LV2/HVN/LV1N & LV2N post insulators, neutral bushings, bushing CTs, Turrets, Conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories. **Please refer BOQ for dimension and other details.**
1.13.1.3	**STATION TRANSFORMER (ST) & UNIT TRANSFORMER (UT):** 56/70 MVA, 21 KV/11.5KV, 3 Phase, ONAN/ONAF cooled, Dyn1, Outdoor with On Load Tap Changers (OLTC)HV/LV1/LV2 post insulators, neutral bushings, bushing CTs, Turrets, Conservator tank, Buchholtz relay, breather & connected pipelines, Cooler control cabinet, common control kiosk, Piping, radiator bank, Marshalling box, valves, fan motors, oil pump motors, instruments and all accessories. **Please refer BOQ for dimension and other details.**
1.13.1.4	**SEA WATER AUXILIARY TRANSFORMERS:** 28/35 MVA, 11/6.9 kV, 3 phase, ONAN/ONAF/Dyn1, Outdoor with HV/LV/LVN Marshalling Box (1350(L)x465(B)x1450(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, shut off valve between Buchholz relay and conservator, Piping, HV, LV bushings. **Please refer BOQ for dimension and other details.**
1.13.1.5	**EXTERNAL CHP TRANSFORMERS:** 20/25 MVA, 11/36 kV, 3 phase, ONAN/ONAF/Ynd11, Outdoor with HV/LV/LVN Marshalling Box (1150(L)x465(B)x1415(H)) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators

	2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping, HV, LV bushings. **Please refer BOQ for dimension and other details.**
1.13.1.6	**AHP AUXILIARY TRANSFORMERS (AAT):** 16 MVA, 11/6.9 kV, 3 phase, ONAN/Dyn1, Outdoor with HV/LV/LVN Marshalling Box (1150(L)x465(B)x1415(H)) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping, HV, LV bushings. **Please refer BOQ for dimension and other details.**
1.13.1.7	**UNIT AUXILIARY TRANSFORMER (UAT):** 12.5 MVA, 11/6.9 kV, 3 phase, ONAN/Dyn1, Outdoor with HV/LV/LVN Marshalling Box (630(L)x250(B)x825(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping, HV, LV bushings. **Please refer BOQ for dimension and other details.**
1.13.1.8	**RO-DM AUXILIARY TRANSFORMER:** 6.3 MVA, 11/6.6kV, 3 phase, ONAN/DyN1, Outdoor with HV/LV/LVN Marshalling Box (630(L)x250(B)x825(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, shut off valve between Buchholz relay and conservator, Piping, HV, LV bushings. **Please refer BOQ for dimension and other details.**
1.13.1.9	**STATION AUXILIARY TRANSFOREMR**: 5 MVA, 11/6.9 kV, 3 phase, ONAN/DyN1, Outdoor with HV/LV/LVN Marshalling Box (630(L)x250(B)x825(H) Conservator (air cell type), OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators 2x50%, cooling fans 6W+2S, OLTC on HV side, Buchholz relay, PRV, shut off valve between Buchholz relay and conservator, Piping, HV, LV bushings. **Please refer BOQ for dimension and other details.**
1.13.1.10	**DRY TYPE TRANSFORMERS:** 2.5 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box. **Please refer BOQ for dimension and other details.**
1.13.1.11	**DRY TYPE TRANSFORMERS:** 2 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type, Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box. **Please refer BOQ for dimension and other details.**
1.13.1.12	**DRY TYPE TRANSFORMERS:** 1.6 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type, Indoor with HV/LV/LVN Bushings, Off

	Circuit Tap Changers, Marshalling box. **Please refer BOQ for dimension and other details.**
1.13.1.13	**DRY TYPE TRANSFORMERS:** 0.63 MVA, 11/0.433 kV, 3 phase, AN cooled/Dyn11, Cast Resin Dry Type, Indoor with HV/LV/LVN Bushings, Off Circuit Tap Changers, Marshalling box. **Please refer BOQ for dimension and other details.**
1.13.1.14	***NOTE:*** • Responsibility of contractors to obtain customer protocols with respect to Field Quality Plan. • SFRA (Sweep Frequency Response Analysis) test shall be conducted for GT & ST. • Before charging the oil filled transformers, Particle Count Test shall be carried out as per latest standards wherever required by BHEL site engineer. • Necessary equipment's T&P to conduct the test shall be arranged by the contractor within the quoted rates. • DGA Analysis for power transformers oil • Frequency of DGA test to be carried out as under. ➢ Before commissioning as benchmark value and to ensure that ➢ the oil has been properly degassed. ➢ Within 24 hrs of charging/operation. ➢ Within one week of 1st charging or operation. ➢ Within 1 month of 1st charging or operation. ➢ Every 3 months Log book to be maintained all records of DGA ➢ test report. ➢ Record of online DGA trends to be recorded. ➢ Precautionary measure to be taken before taking oil sample. • Since gases content are measured in very low magnitude i.e. in terms of parts per million and also its concentration is effected by various parameters like different solubility coefficients of different gases, exposure to atmosphere, air, heat, sunlight etc., therefore it is very important to exercise extreme caution during sampling as well as its storage prior to testing. • Oil can be sampled through sampling valve near bottom and top of tank. Special care has to be taken not to introduce air, dirt, foreign matter or dirty oil into the sampling container. For this purpose, first 1-2 litres of oil from transformer shall be flushed out through the oil container under a turbulent flow so that all contaminants are removed from the oil path and sampling container shall also be

	rinsed with oil. Only Stainless steel or glass bottle shall be used for sampling. It is to be ensured that sample is not exposed to light and it should be perfectly tight to prevent any air ingress. If glass container is used it should be dark in colour. Shape of the container and sampling method shall be as guided by the BHEL site engineer . Also refer IEC-60475. Alternate sampling procedures as per IEC-60475 is also acceptable.
1.13.2	**SCOPE OF WORK OF TRANSFORMER**
1.13.2.1	Receipt of transformer and associated loose supplied accessories & Spares including oil in drums from site store/yard, inspection, preservation with N_2, transporting the above to respective erection location up to plinth, storage, maintenance of N2 gas pressure in transformer tank, erection of transformer and all the accessories including NGR, cabling from transformer accessories to marshalling KIOSK & OLTC panel, oil filling, oil pressure testing, dry out, pre-commissioning test, commissioning of equipment and final painting and handing over. **Note:** Refer Volume-1A, Part-II, and Chapter-4 for General Technical Requirements for erection, testing and commissioning
1.13.2.2	Contractor shall arrange supply of Preservative gas like N2 to maintain the N2 pressure during preservation. (only for preservation purpose).
1.13.2.3	Before loading and transporting the Transformers, contractor shall study the soil condition and identify the route for transportation.
1.13.2.4	Generator Transformer(GT), Station transformer (ST) & Unit Transformer (UT) shall be usually unloaded nearer to the Erection location. The scope of work includes shifting the transformer from this location on to the Transformer foundation and carrying out assembly and testing.
1.13.2.5	All the other transformers except GT, SUT, ST & UT shall be transported from BHEL storage yard in a suitable trailer, unloaded at their respective locations and install as per the installation drawing. The contractor will unload the transformers on rails turn the wheels / rollers if necessary for changing over at right angles on rails, roll the transformers to their respective locations and put them on the foundation. The necessary sleepers, winches, jacks etc., required for this operation will be arranged by the contractor at their cost. The other transformers will be shifted with suitable material handling equipment to the respective location.
1.13.2.6	GT, SBT, ST, UT, SAT, UAT and other transformers shall be dispatched to site in several packages which shall be assembled /erected at site. Contractor shall carry out assembly at site and carry out testing as per requirement.
1.13.2.7	Samples of each and every drum of Transformer oil have to be tested and pre-treated to achieve the desired value before filling in to the transformer tank. The entire arrangement for testing the oil sample, filtering whenever

	required to achieve the desired PPM, BDV within the shortest time shall be made by the contractor. Oil tests as per IS 335 including dissolved gases analysis has to be conducted by contractor for transformers of rating above 200 KV. The job has to be taken up in consultation with BHEL Engineers at site at the cost of the contractor. All the test equipment for testing PPM, BDV of the oil including testing equipment required for the Tan-Delta Test of the transformer winding and HV Bushing shall be arranged by the contractor. HV Bushings shall be tested for capacitance and tan delta test before erection also. Testing instruments required for DEW measurement of N2 gas shall also be arranged by the contractor.
1.13.2.8	The contractor shall arrange suitable filtering machines of capacity 10-12 KL and 5-6 KL / hr capacity (Refer Vol 1A, Part I Chapter VI) to meet the erection / commissioning schedule. Oil filtration shall be carried out periodically to maintain the BDV value of the transformer until handing over the electrical package.
1.13.2.9	All the T & P, material handling equipment including those items mentioned in Cl.No. 1.4.1.0 shall be arranged by the contractor at their cost. The transformers may have to be suitably lagged / covered during the drying out operation by the contractor at no extra cost.
1.13.2.10	During oil circulation of the transformer, the contractor shall employ sufficient number of personnel on three-shift operation to take care of the operation of the filter machine as well as safety of the transformer.
1.13.2.11	Unit and Auxiliary Service transformers shall be bolted to the adopter panel/bus duct on the LT sides and the bus bars shall be connected together. The contractor shall carry out any modification required to match the bus bar or bus duct connection.
1.13.2.12	The contractor shall carry out testing and commissioning works with their own testing equipment and testing teams. Testing shall be done under the supervision of BHEL/customer Engineers.
1.13.2.13	All testing equipment (IMTE) shall be calibrated before putting into service at site. A copy of calibration certificate to this effect shall be furnished to BHEL-Engineer for their verification and approval.
1.13.2.14	All the transformers protective system such as Buchholz relay explosion vent, oil and winding temperature detectors etc., healthiness is to be checked under the guidance of BHEL engineer. All HV bushings will have to be tested for capacitance and tan delta value. All transformers of 220 KV and above shall be tested for capacitance and tan delta value after commissioning.
1.13.2.15	Transformer protective relays are to be checked prior to the commissioning of the transformer.
1.13.2.16	The scope of work shall also include minor civil work such as chipping and grouting of the support structure as well as for the support of the transformer.

1.13.2.17	Final painting shall be carried out for all Transformers. The scope of final painting shall include supply of paints, thinner and other consumables as detailed in the painting clause. No separate rate shall be paid for painting.
1.13.2.18	The contractor shall maintain the equipment erected and commissioned by them until taken over by Customer or till the completion of the contract period.
1.13.2.19	The contractor shall prepare all erection/ commissioning log sheets, protocols/test certificates as per field quality plan, get it signed by the concerned BHEL / Customer Engineer and submit the same to BHEL Engineer as per their instruction.
1.13.2.20	The contractor has to ascertain the quantum of work involved and quote lump sum rate for erection, testing and commissioning of each transformer.
1.13.2.21	Filtration and dry out shall be carried out to obtain value of dielectric strength / PPM, resistivity, specific gravity, dissolved gas analysis, and Tan-Delta test shall be as per recommended value of BHEL. The final tests have to be carried out at approved laboratories like CPRI (before charging of transformer & after charging of transformer) etc. and test certificates are to be submitted to BHEL. If the test results are not satisfactory and if the customer desires to carry out the tests through some other agency, the same shall be carried out at contractor's cost.
1.13.2.22	Contractor shall arrange to paint/stick good quality danger boards where ever required. Required boards shall be arranged by contractor. Name of the equipment erected by the contractor shall be painted boldly as per the agreed colour scheme on the equipment.
1.13.3	**NGR (11 kV & 6.6 kV)** The scope of erection includes minor civil works such as chipping/grouting of support structure, final painting etc. **Refer BOQ for more details.**
1.13.4	**HT SWITCHGEARS -33 kV/ 11kV /6.6 kV & GENERATOR / TRANSFORMER CONTROL / RELAY PANELS AND OTHER CONTROL PANELS INCLUDING DAVR ETC:**
1.13.4.1	**General construction and operation features of HT Switchgear:** HT Switchgear shall be installed in PH building/ ESP Building. The HT switchgears panel consists of a fixed portion (and a moving portion) of modular construction having three high voltage chambers namely breaker chamber, bus bar chamber and CT chamber. Instrument panel is a separate low voltage chamber and shall be supplied with different type of protection relays, Instruments like Meters, Transducers, etc., Moving portion comprises of wheel-mounted truck fitted with an operating mechanism, vacuum interrupters & isolating contacts.
1.13.4.2	**DETAILS OF HT Switchgear**

	A. <u>33 kV</u> System Nominal : 33 kV, 3 PHASE, 50 Hz System Voltage Highest: 36 kV **B. <u>11 kV</u>** System Nominal : 11 kV, 3 PHASE, 50 Hz System Voltage Highest: 12 kV **C. <u>6.6 kV</u>** System Nominal : 6.6 kV, 3 PHASE, 50 Hz System Voltage Highest: 6.9 kV The details of Switchboards are given in BOQ.
1.13.4.3	**Scope of work for HT Switchgear board & Generator / Transformer Control / Relay Panels and other control panels like DAVR etc.,** 1. The scope of work shall include receipt of panels, accessories & spares including rubber mats from site stores/yard, inspection, handling of accessories between stores and erection location, storage, erection of accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over. 2. The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. Wherever the base channels are not available, the same shall be fabricated, erected and painted at site. The material for this shall be supplied by BHEL. Base channels shall be grouted on the opening of the floor. If grouting bolts are required for the panel, the same shall be supplied within the quoted rate. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If base frame is to be fabricated, separate rate shall be paid on Tonnage basis. Contractor to arrange Anchor bolts if required. 3. For the panels to be mounted on the trenches, channel supports shall be provided across the cable trenches over which the base frames of the

	panels shall be mounted. Support structures if required shall be fabricated and separate rate on Tonnage basis shall be paid for the fabrication. 4. Panels shall be delivered in different shipping sections. Necessary interconnection of bus bar, inter panel wiring, etc. shall be carried out as part of panel erection. 5. The contractor shall set each section of equipment on its foundation or supporting structures. The contractor shall assemble equipment as required. Skilled craftsmen arranged by the contractor shall install all equipment with parallel, horizontal and vertical alignment. 6. Generally, the panels shall be supplied with complete Relays/ Instruments and other Components mounted and wired. However, any minor modifications like dismantling of the existing Relays/ Instruments/Components and mounting of new Relays/ instruments /components and rewiring to suit operating conditions, shall be carried out without any extra cost. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra works basis. Similarly, if any Relays/ Instruments /component supplied as loose for safety transit, same shall be mounted and wired as per site requirement at free of cost as part of scope of the job. However, if the loose supplied Relays/ Instruments/Components are more than 10% of the total quantity, the same shall be carried out at extra works basis. Decision of site engineer shall be final regarding such extra works. 7. The commissioning of Switchgear shall also involve the trial runs and commissioning of all connected equipment like motors and Service Transformer. The contractor shall have to keep their people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc. required in the equipment erected by them. (Separate rate shall be paid for commissioning of associated electrical drives as per BOM). Contractor has to co-ordinate with C&I contractors to make the interconnecting cables through.

	8. The contractor shall do touch up painting of switchgear panels wherever necessary. This includes supply of paint also. 9. All T&P, Material handling equipment including cranes, Relay Testing/ HV Testing/ Calibration Instruments, primary/secondary injection kits, CRO, frequency counter etc. shall be arranged by the contractor. 10. Subject to availability, BHEL shall provide EOT cranes for the purpose of shifting the panels within the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P. 11. The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc., 12. One-time calibration shall be carried out for Energy meters in NABL accredited lab if required within the quoted price. 13. Initial loading of software and programming required by proprietary type microprocessor based instruments and protection relays will be done by Original Equipment Manufacturer (OEM). Further injections such as Primary and Secondary injection shall be done by contractor. However overall responsibility lies with the contractor and the contractor shall provide all support like manpower, standard T&P, Instruments etc for calibration and commissioning of above proprietary type instruments. 14. The contractor shall carry out testing and commissioning works with their own testing equipment and testing teams under the supervision of BHEL/Customer Engineers. 15. All testing Instruments/ Equipment deployed to site shall be calibrated before putting it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for their verification and approval. 16. Switchboards incomer bus may be cables/ connected to SP bus ducts through adapter box. The contractor shall co-ordinate for proper bus bar connection. Any modification required in the bus conductor for matching SP bus duct bus bar shall be carried out without extra cost.

17. The contractor shall co-ordinate with cable jointer and other LT cable-laying agency for proper cable termination and also during HV testing of cable.
18. Contractor shall prepare all erection/ commissioning log sheets, protocols/test certificates as per field quality plan, get it signed by the concerned BHEL/ CUSTOMER Engineer and submit the same to BHEL Engineer as per their instruction.
19. The charged and commissioned equipment shall be maintained by the contractor till the same is taken over by Customer.
20. Any items like lamps, lens, fuse/relays/instruments missed/ damaged from the custody of the contractor shall be replaced by the contractor at their cost. However, in case the damage is not due to reasons attributable to the contractor, BHEL may arrange for free replacement. The decision of BHEL Engineer in charge in this regard will be final and binding.
21. If any removal/ Re-fixing of contactors/relays becomes necessary for the completion of the system, the same shall be done by the contractor at free of cost.
22. Rubber mats for switchgear shall be supplied by BHEL, and these shall be laid, wherever required as part of panel erection. However, sufficient quantity of Rubber mats of required voltage level during testing and commissioning of electrical equipment has to be arranged by contractor for safety point of view.
23. Contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer at no extra cost as part of panel erection.
24. Scope of work shall also cover drilling of bottom gland plates for cable entry as required.
25. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments, transducers mounted on the panels.
26. If panels are supplied with monitor, printers, furniture, controller etc., or any loose items or equipment, the erection of above shall be part of

	respective panel. No separate rate shall be payable for loose supplied items unless specifically given in the BOQ. 27. The contractor shall arrange watch and ward for the equipment under their custody and erected in location against theft and damage by other agencies working on the same area. Contractor shall arrange to paint/stick good quality danger boards where ever required. Required boards shall be arranged by contractor. **Note: -** 1. Dimensions & weights indicated in the BOM against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within ±20% shall not be considered for payment. However, for variations beyond ±20%, payment shall be considered proportional to the length of the panel. Variations in depth, height or weight of the panel shall not be considered for payment. 2. Subject to availability, BHEL will provide EOT cranes for the purpose of shifting the panels within the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P. In addition, refer clauses of VOLUME-IA PART – I CHAPTER – V
1.13.5	**BUS DUCTS:** BHEL will supply two types of bus ducts as detailed below. a) HT Isolated Phase Bus ducts from Generator to single phase Generator Transformers. (Main & Delta) b) HT isolated phase bus ducts –Tap off from main to unit / station transformers. c) HT segregated phase bus ducts (11kV / 6.6 kV) between i. Unit Transformer to HT switch boards ii. Unit switch boards to station switch boards iii. Station Transformer to station switch boards iv. Unit Aux Transformer to HT switch boards v. Station Aux transformer to HT switch boards vi. Associated inter connections / Tie bus ducts

	REFER BOQ FOR MORE DETAILS
1.13.5.1	**ISOLATED PHASE BUS DUCTS** 1. The isolated phase bus ducts shall be connected to the low voltage side of the generator transformer and generator. The bus consists of cylindrical/box type conductor made of Aluminum alloy supported on post insulators. Flexible connections and expansions joints are provided at terminal and intermediate points to alleviate stresses due to expansion and to arrest vibration. All the CTs shall be mounted inside the bus ducts. 2. Isolated phase taps connect the potential transformer, surge protection equipment and unit transformer to the main bus. Each phase of protection equipment and potential transformers shall be housed in metal clad cubicles. Delta formation is carried out through delta bus duct. 3. A totally enclosed neutral grounding cubicle is provided to connect the Generator neutral point. The neutral grounding cubicle houses neutral grounding transformer & resistors. 4. Air pressurization equipment unit and Hot air blowing equipment will be supplied with the generator-isolated bus ducts. 5. BHEL will supply one set of shorting bars for generator dry out. 6. The tentative details of bus ducts are as under: 1. Rated Voltage: 27 kV 2. Highest System voltage: 36 kV 3. Type of Bus bar joints: bolted / aluminum welded 7. Any minor drilling or aluminum welding works required at generator end for bolting arrangement of Bellow shall be in the scope of the contractor within the quoted rate.
1.13.5.2	**SPVT Cubicle**

	SPVT Cubicle will be of draw out type with VT mounted on trolleys, complete with accessories like space heater, bus bars, mounting insulators, marshalling box, etc., Each set shall comprise of the following: a. Single phase dry VT 9 Nos. b. Surge Capacitor (24 KV, 0.125 micro Farad) 9 Nos.
1.13.5.3	**LAVT Cubicle** LAVT Cubicle will be of draw out type with VT mounted on trolleys, complete with accessories like space heater, bus bars, mounting insulators, marshalling box, etc., Each set shall comprise of the following: a. Single phase dry VT 3 Nos. b. Lightning Arrestor (36 kV, 10 kA) 3 Nos.
1.13.5.4	**NG Cubicle** NG Cubicle will be supplied with space heater, bus bars, mounting insulators, marshalling box, etc., and shall house the following: a. Dry type epoxy cast NG transformer- 1 No. **b.** Punched Grid type NG Resistor – 1 No.
1.13.5.5	**Bus Duct Supporting Structure** Bus duct supports will be supplied in pre-fabricated condition. In case any additional supports are required, contractor has to fabricate and erect from raw material supplied by BHEL and contractor will be paid as per the rates quoted for the structure fabrication and erection in the BOQ. Bus duct supporting structure fabrication from standard steel section involves welding / bolting and hot dip galvanizing. All structure hardware shall be HTS hot dipped / electro-galvanized.
1.13.5.6	**SEGREGATED PHASE HT BUS DUCTS (SPBD)**

	BHEL will supply 11 KV/ 6.6 KV Segregated phase bus duct complete with Aluminum alloy enclosure and conductor, epoxy resin bus support insulator arrangement, rubber bellows, inspection windows etc. All bolted joints shall have high tensile steel hardware which shall be cadmium plated/ zinc plated and passivated. All conductor bolted joints shall be silver plated. SP Bus ducts shall be connected to LT side of Station Transformer, Unit Transformer, UAT, SAT, HT Switchboards and associated interconnection etc., The tentative details of bus ducts are as under: Insulation level: 28 kV for 11 kV SP 17 kV for 6.6 kV SP
1.13.5.7	**SCOPE OF WORKS FOR ERECTION & COMMISSIONING OF BUS DUCTS** The general scope of works for Isolated/Segregated Phase Bus duct is Receipt from BHEL stores/yards, unloading all the bus duct materials and accessories and equipment as indicated in the BOM and relevant drawings at the area where the bus ducts are to be erected, inspection, installation of all the materials, testing and commissioning of total bus duct items, Final Painting and handing over. Dimensions & weights indicated in the specification / BOM indicated for isolated / segregated phase bus ducts is only approximate. The relevant drawings are enclosed for the purpose of tendering. The contractor has to ascertain the quantum of work involved and quote the lump sum value as called for in the rate schedule. There may be variations in the weight and dimensions. Any variation in the length of Bus ducts within ±10% shall not be considered for payment. However, for variations beyond ±10%, payment shall be considered proportional to the length of the Bus ducts. Variations in width or height or weight including support structure shall not be considered for payment.

	The rate for SP Bus ducts shall include fabrication of supports also. For SP Bus ducts, payment shall be made as per actual length erected. Variations in width or height or weight including support structure shall not be considered for payment. Detailed scope of work shall as below: 1. Transport of Bus ducts and associated items and equipment from BHEL Stores/ yard to erection site. Cleaning of enclosure and conductors, insulators and other panels before assembly and erection. 2. Placement of embedment and erection and alignment of steel support structures. 3. Assembly and checking of bus duct at ground level if necessary. 4. Fixing of wall bushings/wall frame assembly 5. Providing earthing connections as per site conditions. 6. Minor civil work such as chipping and drilling holes on concrete if necessary and grouting of bus duct support structures including supply of materials required for civil works. 7. Carrying out required level of cleaning inside as well as outside of the bus duct for the purpose of conducting high voltage test before commissioning of the unit. 8. Grouting of bus duct and support structures and connecting to earth grid /earth pits as detailed in the relevant bus duct drawings. 9. Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost. (Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures)

	10. Extension of embedment if required and erection of required supports structures as detailed in the drawing. 11. Tightening of all bolts in the joints and flanges by torque wrench to the approved pressure (Anti oxidation compound is to be used for joints and it is in the scope of contractor) 12. Conducting air-tightness test after erection to meet the requirement of BHEL/Customer Standards. 13. Rectification of leakage, if any without any extra charges- For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, Rota meters etc., at their cost. 14. Conducting high voltage test for IP/SP bus ducts, short circuit test for IP bus ducts and other tests as per instruction of BHEL engineer after making necessary cleaning inside as well as outside of the bus duct & arranging all testing equipment required for carrying out bus duct testing. Each bus duct pieces will have to be tested for IR value and HV test at working voltage before erection. 15. Fixing of Space Heaters wiring from space Heaters terminal to junction box, taking through rigid/flexible conduit pipe, Fixing of flexible joints, seal off bushing, rubber bellows, CTs wiring ,conduit/GI pipes breather tapping etc. after testing. 16. Fixing of Current transformers and wiring from CT terminal to junction box/Marshalling box, taking through rigid/flexible conduit pipe. 17. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost. 18. Arranging all T&P material handling equipment required for erection, except those arranged by BHEL.

	19. Calibration of all inspection, measuring and test equipment (IMTEs) before using. 20. Minor Drilling / Aluminum welding for matching BUS duct items including seal off bushing enclosure, core, wall frame assembly, CT, termination at transformer end shall be carried out without any extra cost. 21. Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval. 22. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL/Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer. 23. Maintaining the equipment after commissioning till taken over by customer. 24. Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer VOLUME-IA PART – I CHAPTER – XVI (Painting). Name of the equipment shall be painted boldly as per the instruction of site engineer. Any danger boards required to be displayed shall be arranged by the contractor.
1.13.5.8	**SCOPE OF WORK SPECIFIC FOR ISOLATED PHASE BUS DUCTS:** 1. Erection and commissioning of NG cubicle with all its accessories 2. Assembly, erection and commissioning of SPVT cubicles with its equipment such as lightning arrestors, voltage transformers, fuses, etc., 3. Erection and alignment of TAP OFF bus ducts for unit transformer, SPVT cubicle etc and formation of Delta at LT side of single phase GTs.

	4. Erection and commissioning of Air Blower/drier equipment with all the accessories. 5. Erection and commissioning of air pressurization equipment with all the accessories. 6. Carrying out aluminum welding for bus conductor and on enclosure as detailed in the drawing using MIG/TIG machine with the Aluminum filler wire as per BHEL specification. 7. Providing of MIG/TIG welding machine, aluminum filler wire, Argon gas of high purity and other required consumables as per BHEL standard for efficient aluminum welding, covering supporting insulators with asbestos cloth whenever aluminum welding is carried out near the supporting insulator. 8. Making necessary modifications of make-up pieces, if required, and welding of isolated phase bus ducts along with NGT, SPVT cubicle, UT tap-offs and delta connections. 9. Conducting 10 % X-Ray and 100 % DPT test and arranging the required X-Ray and NDT equipment. 10. Providing well-experienced Aluminum welder to meet the radiography quality. 11. Fixing of neutral side flexible connections to generator and position of neutral CTs after testing. 12. Grouting of bus duct support structures 13. Grouting the ground bus provided on the entire length of entire length of bus ducts, all parts of supporting structures and one end of each enclosure. 14. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost. 15. Arranging all T&P material handling equipment required for erection. 16. Calibration of all inspection, measuring and test equipment (IMTEs) before using. 17. Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.

18. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL / Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.
19. Minor Drilling / Aluminum welding for matching BUS duct items including seal off bushing enclosure, core, wall frame assembly, CT, termination at transformer end shall be carried out without any extra cost.
20. Other requirement for Erection/Commissioning of IP Bus ducts.

    i) Aluminum welders shall appear for test as directed by the BHEL welding Engineer and only test qualified welders shall be permitted to do the welding.

    ii) For MIG/TIG welding only high purity argon gas shall be used. If the contractor is unable to arrange the required high purity Argon gas, the same shall be arranged by BHEL on chargeable basis. The cost of gas shall be recovered from the running bills as per BHEL norms.

    iii) Aluminum filler wire/rod shall be procured in consultation with BHEL Welding Engineer from approved Vendors of BHEL.

    iv) Make up pieces shall be supplied along with bus ducts. Necessary MIG/TIG welding of different sections of enclosures, make up pieces and bus will be carried out at site.

    v) Holes on the flanges may not be adequate or may not match and any additional holes required same shall be drilled at site to facilitate matching of bus duct enclosure flanges including generator flange within the quoted rate.

    vi) Connecting the Bus duct with other equipment erected by other agencies is in the scope of Bus duct erection.

    vii) Any minor modification required in the bus conductor/enclosure of the bus duct for matching the switch gear in-comer and transformer adopted box shall be carried out without additional cost.

21. BHEL will provide **EOT crane** at free of cost. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.

1.13.5.9	**BUS DUCT SUPPORTING STRUCTURES** Each set of bus duct supports is supplied with hot dip galvanized / standard steel sections supporting structure and shall be erected as per drawings. Any additional supports if required shall be fabricated and erected at site. The required material shall be supplied by BHEL free of cost and the further processing like fabrication, zinc phosphate painting; erection shall be carried out by the contractor without any extra cost. In case any additional supports are required, contractor has to fabricate and erect from raw material supplied by BHEL and contractor will be paid as per the rates quoted for the structure fabrication and erection in the BOQ.
1.13.6	**SCOPE OF WORK FOR HT CABLES** a. BHEL will supply HT cables (armoured / unarmoured, Aluminium/ Copper) and Instrumentation cables of different sizes and also Termination Kits/ Joint Kits for HT cables. b. 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. c. The unit rate for laying of HT cables shall also include fixing of Trefoil clamps and clamping as per BHEL specification. Separate rate shall be applicable for installation of HT Termination/ Joint Kits as indicated in Rate Schedule. d. Cable Termination - Termination of HT cable shall be treated as part of installation of HT termination kits and separate rate shall be applicable for the same. - For all other cables, a composite rate covering laying and termination shall be applicable. e. Unit rate quoted for cable shall cover laying, drilling of holes on the gland plates of the panels/JB or Enlargement of cable entry holes by tapping or any modification required fixing of cable glands, fixing of glands, ferrules termination, and providing tag plates and dressing. f. Unit rates quoted for cabling shall also include supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs up to 2.5 sq. mm. apart from the work mentioned above.

	Supply of above material shall conform to the specification detailed in general guide lines. g. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc., h. Ethernet cables shall be isolated from other cables and laid in a separate cable tray as directed by site Engineer. i. The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. For cable joining, if any, separate rate shall be considered on extra works basis. j. 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. k. Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done. l. During testing and commissioning, if the equipment on which the cables are terminated not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling, the contractor shall promptly depute their supervisor or technicians to assist the commissioning agencies to check the interconnecting cables. m. 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. n. The approximate number of termination for the purpose of estimation to be assumed as follows: The average run length shall be considered as 150 metres.
1.13.6.1	**SCOPE OF CABLE TERMINATION** 1. The scope of termination shall include termination of cables on various equipment installed by others. 2. Re-termination if required during testing/ commissioning shall be carried out without additional cost.

	3. Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant and long enough to over pass conductor insulation. 4. Contractor shall arrange all type of termination and crimping Tools/equipment required for the connections/terminations. 5. **Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.** 6. After cable terminations, the debris shall be removed then & there.
1.13.7	**SCOPE OF WORK FOR FABRICATION OF STEEL MATERIALS** 1. Scope of fabrication and installation covers, fabrication and installation of various type of supports for cable tray, Junction Box/Panel, bus ducts etc., with angles and channels of different size. 2. The fabrication steel materials such as angles, channels, plates, etc., shall be supplied in standard lengths by BHEL. Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers. 3. Any minor chipping as required as detailed in VOLUME-IA PART –I CHAPTER -X, including supply of all cement, sand etc. as required for grouting of supports are in the scope of contractor, the same shall be carried out at free of cost. After installation of frames, supports the grouting of the same is in the scope of contractor. 4. If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost. 5. For fixing frames or support if any minor grouting is required the same shall be carried out by the contractor. After installation of frames, grouting of the same is in the scope of contractor.

	6. A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required.
1.13.8	**SCOPE OF CIVIL WORKS** 1. In addition to the scope of works as detailed in VOLUME-IA PART –I CHAPTER –XII, the following scope of civil works shall be carried out by the bidder within the quoted price. Minor civil works like drilling, chipping for transformer /bus duct foundations and punching & opening in concrete floors, slabs, brick walls, grouting of bus duct columns, base frame of panels, Transformer etc. including supply of cement, sand, concrete etc., cleaning of all debris due to electrical installation. 2. The scope of civil works includes supply of grouting materials like grouting cement, sand etc., and cleaning of all debris. 3. No separate payment will be applicable for above civil works.
1.13.9	**SCOPE OF CALIBRATION** 1. Contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, Recorders, Indicators etc. that will be supplied along with equipment mounted in or in loose. 2. Contractor shall maintain calibration records as per the BHEL prescribed format. 3. All testing Instruments/ Equipment deployed for calibration shall be calibrated before taking it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for their verification and approval. 4. All testing instruments shall have calibration certificate issued by recognized/accredited agencies.

	5. Contractor has to calibrate all the instruments covered in their scope and maintain the calibration records as per the relevant FQP formats. 6. Initial loading of software and programming required by proprietary type microprocessor based instruments and protection relays will be done by Original Equipment Manufacturer (OEM). Further injections such as Primary and Secondary injection shall be done by contractor. However overall responsibility lies with the contractor and the contractor shall provide all support like manpower, standard T&P, Instruments etc for calibration and commissioning of above proprietary type instruments. 7. If BHEL is unable to provide or arrange OEM support for above mentioned proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by outside agency shall be reimbursed by BHEL. However if above such calibrator is available with BHEL at site the calibration shall be carried out by the contractor within the quoted rate.
1.13.10	**LUMPSUM UNIT RATE** Unit rate to be quoted on lump sum basis shall include installation of all loose items which are not explicitly mentioned, but comes as part of the system, integration of total system and commissioning. No separate rate shall be payable for loose items. The quantities of loose supplied items are approximate only. No proportional rate will be applicable for any variation in quantity or for any additional items supplied as part of equipment.
1.13.11	**SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY OTHER CONTRACTOR.**
1.13.11.1	**ALL TYPES OF HT DRIVES AND GENERATOR** **a-** Cable identification, checking and meggering. **b-** IR value of motor, measurement of winding resistance etc. **c-** Measurement of Inductance and capacitance of winding **d-** Dry out all the motors if required to improve IR value. **e-** Checking direction of rotation of motors and testing and commissioning from local as well as remote.

	f- Checking the bushing and HV test/Tan delta test **g-** Attending to any defects till the handing over of the unit to customer ***Note:*** For the purpose of successful commissioning of the HT Drives and Generators erected by other contractors, any peripheral Electrical item needs to be erected shall be carried out by the bidder within the quoted rates.
1.13.11.2	**PANELS** The panels shall be mostly skid mounted and the skid will be erected by mechanical contractor. The scope of commissioning of Panels covers checking of internal wiring and associated loop cables from panels to field instruments, Push Buttons, JBs, drives, replacing defective components/instruments/electronic cards etc. If any loop cables (power or control) are to be laid or replaced, the same shall be carried out at unit rates available in the BOQ. For commissioning of associated drives, if any, the unit rate will be as per BOQ and this will not be part of panel commissioning.
1.13.11.3	**NOTE:** **1.** The scope of work also includes collecting the replacement instruments/parts from BHEL/customer stores, stockyard etc. 2. Separate group shall be identified for commissioning. The above group shall be available right from Trial run to full load operation including shift operation.
1.13.12	**RIGID & FLEXIBLE CONDUITS** 1. Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe/flexible conduits shall be used as per instruction of BHEL Engineer. 2. The scope of works for flexible conduit includes drilling of the holes on the plates fixing of the end connectors, providing suitable supports and fixing tag marks wherever specified as required by BHEL. The supply of suitable clamps, fasteners and tag plates are in contractor's scope.

1.13.13	**SCOPE OF WORK OF JUNCTION BOXES/ MARSHALLING BOX/STARTER BOXES AND PUSH BUTTON BOXES:** Different type of Electrical Junction boxes/Push button boxes shall be supplied. The scope of installation of Junction boxes/Push button boxes shall be as follows: 1. The unit rate quoted for erection of junction boxes/push button boxes shall include providing necessary supports, drilling of bottom gland plates for cable glands as required, Painting the tag No of JB or fixing a separate tag plate as required on junction boxes/push button boxes, minor chipping, grouting as required for mounting the JBs/PB and supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button. 2. Fabrication and fixing of supports shall be on tonnage basis. 3. The contractor shall close all unused holes on the gland plates using GROMMET or other suitable material issued by BHEL, within the quoted rate. 4. All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor. 5. If any intermediate JBs are required to terminate power cables for drives, the same shall be installed and also any modification like replacement of terminals, enlarging gland holes etc. required to accommodate power cables shall be carried out as part of this works. **6.** Equivalent Unit rate shall be paid for installation of such JBs. Decision of site engineer will be final regarding the equivalent rate.
1.13.14	**SCOPE OF ABOVE GROUND EARTHING & LIGHTNING PROTECTION** 1. Earthing scope also covers, earthing of all cable trays, metallic frames of all current carrying equipment, supporting structures adjacent to

	current carrying conductors, Transformer, Bus ducts, panels, motors, JB, push button boxes etc as required. 2. Drawings of main earth grid to be provided by others would be made available to the contractor to enable them to carry out rest of the earthing system work. 3. Different type of earthing materials shall be supplied by BHEL and the contractor shall lay and connect the earthing materials as per site requirement. Unit rate for earthing material shall be paid on meter basis if appearing in the BOQ. 4. The connection between earthing pads/ terminal to the earth grid shall be made short and direct and shall be free from kinks and splices. 5. Generator neutral from the NGT/NGR cubicle shall be earthed using two dedicated rod electrodes, which shall in turn be connected to the main plant grid. 6. Installation of treated earth pit as per IS:3043 including providing concrete chamber with CI cover(hinge type) and nomenclature/identification of the pit. (Only GI pipe & funnel shall be supplied by BHEL)
1.13.15	**SCOPE OF WORK FOR FABRICATION & INSTALLATION OF STEEL MATERIALS** 1. Scope of steel fabrication and installation covers, fabrication and installation of various type of supports for Junction Box/Panel, bus ducts etc. with angles and channels of different size 2. The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL. Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers. 3. For fixing frames or supports if any minor grouting is required the same shall be carried out by the contractor. After installation of frames, grouting of the same is in the scope of contractor.

	4. Supply of all cement, sand etc. required for grouting of supports is in the scope of contractor. 5. A composite rate shall be derived 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.

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

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 non-conformities.

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

1.14.8 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes / ferrules / lugs) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL formats.

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

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

VOLUME-IA PART - I CHAPTER- XV

TESTING AND COMMISSIONING

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

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

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

a. Trial run of various equipment
b. Light up of boiler
c. Boiler chemical cleaning
d. Boiler alkali boil out
e. Turbine barring gear
f. Steam blowing of piping
g. Turbine rolling
h. Safety valve floating
i. First synchronization
j. Heavy oil firing and synchronization
k. Coal firing
l. Trial Operation/Full Load

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

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

1.15.1.3 The pre-commissioning activities of the main power plant will start with energizing of startup power supply systems followed by trial run of various drives prior to light up of boiler. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by them to match with the various milestone activities /commissioning program of the project. All these works need specialized testing engineers, supervisors including electricians in each area to co-ordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark separate manpower for various

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

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

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

1.15.1.6 Any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at their cost. During commissioning, any improvement rework / rectification / modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.

1.15.1.7 Minimum requirement of Man Power for testing/checking works shall be as follows: (Requirement given below is per unit):

HT Portion:

	Transformer	**Busduct**	**HT Switchgear**
Engineer	1		2
Supervisor	2	1	3
Technician	3	2	6

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

1.15.1.8 All T&P / instruments required for testing including the Generator Circuit Breaker (27 kV) are to be arranged by the contractor.

1.15.1.9 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.

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

1.15.1.11 All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications.

1.15.1.12 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.

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

1.15.1.14 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.

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

1.15.1.16 Recommissioning of any item listed in BOQ (drives of soot blowers, MOV etc) as per site requirement is to be done by the contractor without any extra claim.

1.15.1.17 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.

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

1.15.1.19 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.

1.15.1.20 During commissioning any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.

1.15.1.21 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.

1.15.1.22 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.

1.15.2 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY OTHER/ MECHANICAL CONTRACTOR:

The scope of commissioning assistance to be provided by the contractor will cover the equipment / drives erected by the mechanical contractors as detailed in the BOQ and in relevant clauses of VOLUME-IA PART – I CHAPTER- XIII

1.15.2.1 All types of Drives and Generator:

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

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, Transformers, Bus ducts and GCB besides touch up paints wherever required. Full painting shall be required for specific equipment's as per the scope of erection.

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

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

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

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

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

1.16.1.8 Spray painting has to be carried out within the Quoted rates for Transformers, Bus-ducts and GCB. 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.,

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.

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

1.16.2 PRESERVATION / TOUCH UP PAINTING

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

1.16.2.2 Mostly the equipment / items/ components will be supplied with one coat of primer paint and one coat of finish paint. However, during storage and handling, the same may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour. Besides above two coats of approved primer paint are 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 color.

1.16.2.7 **Paint Shade of transformers/Bus ducts: (Please refer Volume-IA Part-II Chapter 1)**

VOLUME-IA PART – II CHAPTER 1
PAINTING SCHEDULE

2.1.	PAINTING SCHEDULE	
Sl.No.	**Equipment/Area**	**Painting Schedule**
1	**IPBD/SPBD**	1. Paint Shade: Light Grey -Shade No. 631 (as per IS: 5) 2. DFT of Epoxy paint (min) – 50 Micron 3. Total Thickness of Paint (min): 100 Microns (Paint shall be applied in two coats to give a min. DFT of not less than 50 microns)
2	**275 MVA 21/(420/√3) kV I-Phase Generator Transformer (GT)**	
2.a	Transformer Tank & Cover, Top & Bottom of the tank, Turrets, Inspection Covers, Conservator, Headers, A-Frames, Pipe Works etc.	1. Paint Shade: 631 to IS 5 2. i. Chemical & Thermal Resistant Epoxy Zinc Phosphate primer-50 mm(min) ii. Epoxy HB MIO – 75 mm (min) iii. Polyurethane finishing paint -50 mm (min) Total DFT: 155 mm (min) 3. No. of coats shall be given to achieve the DFT as mentioned above. 4. How to apply: Spray (or) Brush
2.b	End frame, Clamp plate, Cross Beam, T.G & T.C Brackets, other steel parts going inside Transformer Tank	1. Chemical & Thermal Resistant Epoxy White Paint 2. Total DFT: 155 mm (min) 3. How to apply: Spray (or) Brush
2.c	Radiator	1. Paint Shade: 631 to IS 5 2. i. Chemical & Thermal Resistant Epoxy Zinc Phosphate primer-50 mm(min) ii. Polyurethane finishing paint -50 mm (min) Total DFT: 100 mm (min) 3. No. of coats shall be given to achieve the DFT as mentioned above. 4. How to apply: Spray (or) Brush
3	**110 MVA/70 MVA/35 MVA/25 MVA/16 MVA/12.5 MVA Transformers**	
3.a	Transformer Tank & Cover, Top & Bottom of the tank, Turrets, Inspection Covers, Conservator, Headers, A-Frames, Pipe Works etc.	1. Paint Shade: 631 to IS 5 2. i. Chemical & Thermal Resistant Epoxy Zinc Phosphate primer-50 mm(min) ii. Polyurethane finishing paint -50 mm (min) Total DFT: 100 mm (min) 3. No. of coats shall be given to achieve the DFT as mentioned above.

		4. How to apply: Spray (or) Brush
3.b	End frame, Clamp plate, Cross Beam, T.G & T.C Brackets, other steel parts going inside Transformer Tank	1. Chemical & Thermal Resistant Epoxy White Paint 2. Total DFT: 50 mm (min) 3. How to apply: Spray (or) Brush
3.c	Radiator	1. Paint Shade: 631 to IS 5 2. i. Chemical & Thermal Resistant Epoxy Zinc Phosphate primer-50 mm(min) ii. Polyurethane finishing paint -50 mm (min) Total DFT: 100 mm (min) 3. No. of coats shall be given to achieve the DFT as mentioned above. 4. How to apply: Spray (or) Brush
4	**6.3 MVA/5 MVA Auxiliary Transformers**	1. Paint Shade: 631 to IS 5 2. i. Primary Coat of Zinc Chromate – 70 micron (Drying time 4 hours) ii. Secondary Coat of Varnish – 70 micron (Drying time 4 hours) iii. Under coat (First coat) paint – 70 micron (Drying time 8 hours) iv. Final Paint - 70 micron (Drying time 6 hours) 3. No. of coats shall be given to achieve the DFT as mentioned above. 4. How to apply: Spray (or) Brush
5	**0.63/1.6/2/2.5 MVA Dry type transformers**	1. Paint Shade: Synthetic Enamel paint Shade RAL 7032 2. i. Anticorrosive Priming Paint (Red) – 90 to 140 micron (Drying time 12 hours) ii. Anticorrosive Priming Paint (Brown) – 90 to 140 micron (Drying time 12 hours) iii. First finishing coat of paint – 90 to 140 micron (Drying time 12 hours) iv. Second finishing coat of Paint - 90 to 140 micron (Drying time 16 hours)

VOLUME-IA PART- II CHAPTER -2
DATA SHEET

2.2.1 DATA SHEET

2.2.1.1 SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

1. Ferrules / Fire stop cable sealing system / tags: As per Clause 2.5.11.
2. Tag
   - i. Material : Aluminium / Fiber / Stainless Steel
   - ii. Markings: Engraving / Embossing / Printing
   - iii. Size : As required
3. Cable lugs of size 2.5 Sqmm and below : Copper (crimping type)
4. Anchor fasteners for wall mounted cable trays / JBs
5. Insulation tapes
6. Paints required for primer & final coating and for protective coating
7. Solder wire (Lead) -(60/40)
8. Panel sealing compound material (for cable entry from bottom / top of Panel)
9. Materials required for cable dressing. (GI / aluminum flats, PVC ties etc).
10. PVC wire marker sleeves and Tag plates
11. Welding electrodes, filler wires, gases etc
12. Metallic clamps for flexible and rigid conduits

2.2.1.2 Wastage Allowance:

Material	Allowance permitted
Support Installation	1% by weight
Structural Steel	2%
Cable Tray	2%
HT/LT Cable	1%
Control Instrumentation Cable	2%
Earth flats	2%

VOLUME-IA PART- II CHAPTER -3
TECHNICAL REQUIREMENTS AND GUIDELINES FOR INSTALLATION, TESTING, COMMISSIONING AND SUPPLY ITEMS OF HT ELECTRICAL PACKAGES

2.3. TECHNICAL REQUIREMENTS AND GUIDELINES FOR INSTALLATION, TESTING, COMMISSIONING AND SUPPLY ITEMS OF HT / LT ELECTRICAL PACKAGES

2.3.1 INSTALLATION, TESTING & COMMISSIONING IN GENERAL:

The stages of completion of various works shall be as follows:

- Equipment shall be considered to be completely erected when the following activities have been completed.
- Moving of all equipment to the respective foundations.
- Fixing of anchor bolts or tack welding as required.
- Leveling and alignment of equipment.
- Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in the job specification.
- Filtration and filling of oil as required.
- Cable laying, termination with continuity check.
- Applying of finishing coat of paint.

All the equipment shall be tested at site to know their condition and to prove suitability for required performance. The site tests and acceptance tests to be performed by contractor are detailed below.

The contractor shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.

2.3.2 SITE TESTS AND CHECKS:

2.3.2.1 GENERAL:

All the equipment shall be tested at site to know their condition and to prove suitability for required performance.

The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual has to be conducted at site.

In addition to tests on individual equipment some tests / checks are to be conducted / observed from overall system point of view. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated and shall be finalized with consultation of client before charging of the system.

The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

All checks and tests shall be conducted in the presence of client's representative and test results shall be submitted in six copies to client and one copy to Electrical Inspector. Test results shall be filled in proper proforma.

After clearance from Electrical Inspector system/equipment shall be charged in step by step method.

Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging are to be brought by the contractor.

2.3.2.2. **Trial Run Test:**

After the successful test of each equipment as per standard test procedure the entire control system shall be put on trial run test on actual site conditions and operation of the system.

2.3.2.3. **Acceptance Test:**

The acceptance test on the system shall be carried out by the supplier as per mutually agreed test procedures to establish satisfactorily functioning of the system as a whole and each equipment as part of the system.

2.3.3 **BUS DUCTS – ISOLATED / SEGREGATED PHASE BUS DUCTS**

2.3.3.1. **HANDLING AND STORAGE:**

General:

Bus duct form the main electrical connections between the Generator and associated generator transformer and tap-off to UAT, VT & SP cubicle and GCB. The ducts are made of aluminium sheet which house the bus bar conductors supported on post insulators. The duct assembled are suitably supported on the structures in the station. The bus enclosure assembled are dispatched with the insulators assembled and the conductor are sent either loose or assembled inside the duct, keeping in view the erection necessities and transport limitations.

2.3.3.2. **INSPECTION AT SITE:**

When the packages are received at site, these must be checked for the following:

a. Completeness and correctness of the consignment. (Compare with delivery documents)

b. Physical damage if any during transit.

2.3.3.3. **HANDLING DURING ERECTION:**

The bus ducts are in unpacked conditions, therefore, great care is necessary in handling. Ensure that:

a. While lifting enclosure assemblies' manila ropes are passed round the bus duct enclosure near the support channels.

b. All shipping steel clamps are to be tightened and bus bars do not slip out while handling, if the bus bar is assembled in the enclosure.

c. While inserting and mounting the bus bar in the enclosure care is taken that the bus bar does not hit and damage the insulators.

d. Eye bolts are used while lifting the cubicles.

On completion of clause 2.4.3.3 items must be returned to original packing cases unless required for immediate erection.

Caution:

1. When inspecting the enclosures assemblies etc. the wooden packings, braces and polythene covers should be replaced, if removed, to prevent damage and ingress of duct and moisture.
2. Aluminium being softer material, great care must be taken in handling enclosures and other aluminum items.
3. If the site conditions make it impossible to return the items to the cases for storage:
   a. Nothing must be laid direct on the ground.
   b. All items must be protected against weather and damages.

2.3.3.4. **HANDLING OF BUS DUCT:**

Handling from delivery station to power station stores:

1. Use suitable slings to lift the packages
2. No impact should come on the packings while loading. Do not drop from height.
3. Do not stack bus duct packings one above the other; also avoid stacking of heavier items on bus duct packings.

2.3.3.5. **DURING UNPACKING, HANDLING AND STORAGE**

DO's:

1. Check all the packings for any damage during transit.
2. Open the packings carefully.

3. Verify material as per shipping list and report any shortage / damage immediately.
4. Keep material in original packings unless required for erection.
5. Ensure that Manila ropes are used for lifting the bus duct.
6. Check the tightness of shipping steel clamps while lifting bus duct assembly with bus bar in position.
7. Ensure that CTs, LAs, capacitors, N.G. transformer, grounding resistor, fuses, insulators, wall bushings, molded and rubber items and flexibles are stored in well-ventilated area.

DON'Ts:

1. Don't destroy any markings.

2. Don't drop packings from height.

3. Don't stack heavier items on bus duct packings.

4. Don't keep door of cubicle open during storage.

5. Don't lay down unpacked material directly on the ground.

6. Don't cause damage or scratches by dropping, dragging etc. on fragile items such as CTs, PTs, Insulators, rubber items etc.

2.3.3.6. **DURING ERECTION & COMMISSIONING:**

DOs:

1. Carry out pre-lay survey to verify the position of various equipment to be connected, levels of floors and positions of cutouts.
2. Keep the layout drawing etc. ready for reference.
3. Draw the material from stores as per erection sequence.
4. Ensure alignment and proper matching of various enclosures and bus bars.
5. Ensure proper alignments of epoxy cast CTs and seal-off bushings before final tightening of hardware.
6. Make the bus bar joints as per the instructions.
7. Ensure aluminium welding by qualified welder only.
8. Take care for proper sealing while joining the enclosure.
9. Ensure proper earthing of enclosure and structure as specified.
10. Check wiring as per relevant wiring diagram.
11. Ensure that CT secondaries are shorted and grounded before HV test on bus duct.

12. Ensure that HV test at rated voltage is carried out for IP bus ducts before erection and IR value for all sections of SP and NSPB bus ducts

DON'Ts

1. Don't allow accumulation of dirt or foreign material inside the enclosure during erection.
2. Don't overtight the bolts.
3. Don't hammer the bolts etc. while joining the bus bars if holes are not matching.
4. Don't forget any foreign material inside the enclosure.
5. Don't allow aluminium welding by unqualified welder.
6. Don't subject IAS, capacitors, and PTs to HT test as these are pre-tested and test at site is not required.
7. Don't subject NG transformers to over voltage as these are pre-tested.
8. Don't apply rated voltage to full bus duct unless pre commissioning checks are completed.
9. Don't apply any voltage to bus ducts when the ends are connected to equipment like transformer and generator.
10. Don't apply high voltage with surge arrestor and lightning arrestors in circuit.

2.3.3.7. **ERECTION INSTRUCTIONS:**

A. Packing and Shipping:

Layout drawing and main bill of material (M.B.O.M) or shipping list should be referred to for identification of various items. All the drawings necessary for assembly and erection are furnished separately.

IP Bus ducts are usually dispatched as single phase assemblies generally assembled with bus bars. The bus bars are braced with steel clamps to avoid any damage to insulators and displacement of bus bars during transport. Structures, hardwares, flexibles, and other miscellaneous items are packed separately.

B. Marking:

Following markings are done with paint on bus duct assemblies and cubicles for identification:

a. Project name and unit number
b. Item no of main BOM this is encircled
c. Phase marking R, Y or B
d. Work order number

e. Drawing number and item/variant number

f. Arrow indicating direction towards transformers end. Direction of arrow shall be decided from lay out.

Similarly loose items are also identified by suitable marking on tags.

2.3.3.8. **PRE-LAYOUT SURVEY:**

Before starting the erection work the centre lines of the complete bus duct installation, location of connected equipment such as main transformer, unit auxiliary transformer, VT & SP cubicle, NG Cubicle etc. with respect to generator central line should be established and marked clearly. The various levels of floor, ceiling, terminal position of main transformer, unit auxiliary transformer etc. should also be verified. Any deviations in this regard should be recorded and necessary remedial measures should be taken. In case of any substantial deviation which may affect the erection of bus duct installation, the same should be referred to the design engineer. The remedial measures should be planned in advance, which may consist of levelling by suitable packers chipping of the concrete floor or wall etc. or rectification of the components with the concurrence of engineers.

2.3.3.9. **PROVISION OF FOUNDATION BOLTS & EMBEDDED ITEM:**

In the power station, bus duct is supported on various floors, halls, ceiling, etc. and support structure is suitably attached to the building. For this foundation bolts, embedded items are grouted at number of locations as per foundation drawing.

2.3.3.10. **SEQUENCE OF ERECTION:**

Normally the following sequence of erection is recommended.

A. Erection of steel work :

First, all the vertical structures are to be installed, leveled and foundation bolts grouted. Next, place all the longitudinal cross channels in position, adjust the level and bolt / weld them.

Check up the correctness of levels and positions of various installed structures. For installation of foundation bolts refer foundation details drawing of the project.

B. Erection of Enclosures:

Before the installation of enclosures in position each assembly of enclosure and conductor complete with insulator supports is to be checked for correctness and cleaned on the working floor.

The various enclosures assembled are to be erected as per layout drawing. After placing the assemblies in position the packing braces / steel clamps inside the ducts are to be removed.

Some of the bus duct assemblies will be self-supporting only when they are welded to adjacent enclosures, as such some temporary scaffolding is necessary to support these enclosures during erection, leveling and welding.

C. Handling of Bus ducts:

For handling of bus ducts specified instructions should be followed.

D. Sequence of erection-enclosure assemblies:

In positioning the various enclosures assemblies, the following sequence is recommended:

E. Indoor Portion:

(a) Neutral Side

Complete the assembly of top chamber/neutral shorting chamber at the working floor as per the drawing. Connect copper flexible on the generator neutral terminals, and fix it with the generator plate. Provide temporary support as necessary. Complete the assembly of bottom chamber (if applicable) along with CTs and wiring as per drawing at the working floor and match with the top chamber (if applicable). Now fix the supporting structure. Assemble N.G. Transformer and N.G. Reactor and complete the terminal connections.

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

(b) Line Side

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

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

F. Outdoor Portion:

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

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

The alignment and exact locations of ducts may be verified before

proceeding for making the assemblies of make-up piece rubber bellows, wall frame and bolted/welded joints of conductor and enclosures.

G. Bus bar Joints:

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

H. Cleaning of Bus duct

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

I. Inspection of windows, covers, etc.

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

2.3.3.11 **BUS BAR BOLTED JOINTS:**

A. Aluminium to Aluminium Joints (Un plated):

1. Wipe the contact surfaces with dry clean cloth to remove any dirt, dust and moisture and smear these with recommended jointing compound.
2. Clean the surfaces under the compound by breading with dry coarse emery cloth or stainless steel wire brush. Wipe the surfaces with a clean dry cloth and immediately make a light application of jointing compound.
3. Close up the joints and wipe off excess compound.

B. Aluminium to Copper Joints:

1. Cleaning of Aluminium surface (Unplated)
2. Follow Instructions given under clause 2.5.4.0 (A) above and apply jointing compound.
3. Cleaning of copper surfaces (unplated)
4. Clean the copper contact surface with emery cloth and wipe the surface with clean dry cloth.
5. Cleaning of copper aluminium surfaces (unplated)

6. Clean the contact surface with dry cloth to remove dirt, dust and moisture. Apply a light coating of jointing compound.

C. Aluminium to Copper Joints using bimetallic strip:

1. For cleaning of aluminium and copper surfaces follow instructions given under 2.5.4.0 (A&B) above. Apply jointing compound to aluminium and copper surfaces.
2. The contact faces of bimetallic strip should also be cleaned as per the above practice and jointing compound applied. Bimetallic strip will be provided by BHEL.

Note: Bimetallic strip is inserted between the copper and aluminium surfaces. Care should be taken that copper faces copper surface and aluminium faces aluminium surface.

D. Cleaning of copper surfaces (plated):

Clean the contact surface with dry cloth to remove dirt, dust and moisture.

Note: Wire, brush, emery cloth or jointing compound containing metallic particles or other abrasives should not be used on plated surfaces.

2.3.3.12 **CONTACT PRESSURE:**

To obtain correct tightening pressure on contact surfaces following torques are recommended for various bolt sizes.

Bolt Size	Recommended Torque	Torque Spanner Capacity
M10	0.85 to 1.3 NM (20-30 Ft-lb)	0.85 to 1.3 NM (20-30 Ft-lb)
M12	1.3 NM to 1.7 NM (30-40 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)
M16	1.7 to 2.1 NM (40-50 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)
M20	2.1 to 2.5 NM (50-60 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)

Alternatively tighten the nut till belleville washer becomes flat. Then unscrew the nut by about 1/8th turn.

2.3.3.13 **RECOMMENDATION FOR WELDED JOINTS**

A. Circumferential weld circular section:

A FULLY penetrated; fully fused welded with a 10%T (4mm max) reinforcement is required.

Welding conditions M.I.G. Process

Filler wire	1.6mm dia (NG 21 with 5% silicon)
Angle	10° to 15° Forehand
Cleaning	Decrease and scratch brush
Setting	250A to 320A, 28 to 30 Volts (Dependent on thickness)

Process	4 off 25mm long equi spaced tack welds
Gas Supply	50 Cu. ft/hr argon – 10-12 Lits/Min.Argon
Shield	5/8" dia
Purity	99.98%

B. Tubular Conductors:

Tubular Conductors are used in tee-off connections.

Welding conditions M.I.G. Process

Filler Wire	1.6 mm dia (NG 21 with 5% silicon)
Angle	10° to 15° Forehand
Cleaning	Degrease and scratch brush
Setting	215A to 275A, 22 to 2 Volts
Gas Supply	50 Cu. ft/hr argon
Shield	5/8" dia
Purity	99.98%

C. Enclosures

Fillet weld for make up pieces/shunts. Tack weld at four places.

Welding conditions M.I.G. Process :

Filler Wire	1.6 mm dia (NG 21 with 5% silicon)
Angle	10° to 15° Forehand
Cleaning	Degrease and scratch brush
Setting	200A to 300A, 25 to 30 Volts (Dependent on thickness)
Gas Supply	50 Cu. ft/hr argon
Shield	5/8" dia
Purity	99.98%

D. Drain valve and welding :

Owing to the dissimilar thickness used for this fillet weld, the arc must be directed into the pad only and not allowed to melt away and enclosure.

2.3.3.14 **WELDED BUS ENCLOSURE JOINTS:**

Bridge the gap between the bus enclosure by means of make up pieces and clean the area by paint removed which is to be welded. Tack weld the make up pieces before final filled weld all around.

2.3.3.15 **WELDED JOINTS OF SHUNTS:**

Various locations of shunts to be welded to the enclosures are shown in layout drawing.

2.3.3.16 **DRAIN VALVE WELDING (IF APPLICABLE):**

Mark the location as per lay out and drill 10mm dia hole at the bottom most point of enclosure. Tack weld the drain valve pad to enclosure ensuring proper alignment of paid hole with enclosure hole. Weld continuously as per jointing recommendations. Clean with wire brush and point for final finish.

2.3.3.17 **FIXING OF NEOPRENE SEAL :**

Enclosures are fitted with access covers. Each cover is fitted with four pieces of neoprene seal and held in position by bolted clamps.

(Note: Only one cover should be removed from enclosure at any time to minimize the air flow into the enclosure).

2.3.3.18 **EARTHING OF ISOLATED / SEGREGATED PHASE BUS DUCT AND CUBICLES**

A. General

One end of the electrical continuous enclosure should be earthed to station earth at the shunt location where all the three enclosures are shorted. Location of earth points are shown in the layout drawing. For this purpose, two drillings are to be done on these shunt to suit at site and two separate earth strap are to be connected to the station earth thus ensuring double earthing.

In some assemblies (such as transformer hood etc) due to short length of enclosures shunts are not provided. In such cases, each phase enclosure should be separately earthed.

One point of the earth phase split cover, rubber bellow clamping strap should be electrically connected to enclosures and in turn enclosures should be earthed.

B. Cubicle earthing :

Each cubicle is provided with two number of earthing terminals. These terminals are generally located on side face of the cubicle. Both the terminals are to be connected independently to the station earth by suitable connectors.

For earthing the top and bottom C.T. chambers, station earth can be connected to each chambers of two locations for double earthing.

2.3.3.19 **SITE TESTS ON ISOLATED /SEGREGATED PHASE BUS DUCT**

A. Physical Checks :

Design survey which include dimensional checking of electrical clearances and cleanliness of the installation.

B. Cleanliness :

The inside of all enclosures, outside of conductors and insulators should be free from dirt, all, grease, swaft and any deposits, special attention should be paid to the insulators and seal off bushings and oil moisture is to be removed and surfaces polished with a dry soft clutch. All panels/inspection windows cover are to be replaced after cleaning operation.

C. Power Frequency High Voltage Test

Preparation :

1. Following equipment must be disconnected from bus bars removing the bolted link and grounded suitably prior to conducting this test:
    a. Generator terminals
    b. Unit auxiliary transformer terminals
    c. Generator transformer terminals
    d. Neutral grounding transformer HV terminal
    e. Lightening arresters
    f. Capacitors
    g. Potential transformer.
2. It is important to ensure that secondary of all the current transformers mounted on bus bars are shorted and grounded properly before conducting this test.
3. Ensure that all insulators seal-off bushings are cleaned free from any dust, grease and moisture etc before test.
4. During the test, ensure the following
    a. The generator rotor is kept stationary
    b. H.V. Circuit breakers on system side are kept in the open position.

D. Test Voltage:

1. The test voltage shall be attenuating current on any frequency between 25 hertz to 100 Hz and approximately of sine-wave form. The r.m.s. value shall be as given in table-1 below:
2. For A.C. voltage duration of test shall be one minute.

3. The test with D.C. at a voltage not in excess of the values given in Table-1, Column-3 for the corresponding rated voltage may be substituted for the AC test prescribed.

Table – 1

Rated Highest System Voltage- Up to & Including	Test Voltage (A.C.)- KV	Test Voltage (D.C.)
3.6	16.8	
7.2	21.6	
12	28	
24	44	
36	60	

E. Megger-Checks:

Before the application of high voltage, check the insulation of each bus, conductors by means of 2.5 KV megger. A value e. 100 mega ohms is expected under normal conditions. However, during rainy season this value may fall down considerably and drying up by hot air may be necessary before the test. Minimum acceptable value is around 20 mega ohms. After the application of high voltage the insulation value is checked gain.

F. Application of Test Voltage:

Corresponding test voltage as indicated in Table-1 shall be applied in turn between each phase conductor and its enclosure which shall be kept at ground potential. Remaining two phase conductors and their enclosure shall be properly as in consistent with its value being indicated by the measuring instrument. The full test voltage shall be then maintained for specified duration. Each bus including tap-off must withstand the above test voltage.

2.3.3.20 **SITE TEST RECORDS ON ISOLATED PHASE / SEGREGATED PHASE BUS DUCTS :**

Test conducted on date..... Site .....

Power Frequency high voltage test :

Instrument .....

Phase	Meggar Reading after		HV applied&	Leakage current	Remarks
	before HV	before HV			

	test	test	duration	A.C./ D.C.	
R					
Y					
B					

2.3.4.0 **TRANSFORMER**

2.3.4.1 **INSTALLATION:**

To ensure that a Transformer will function satisfactorily, it is important that handling, lifting, storing and assembling are carried out with great care and cleanliness by experienced personnel who know the various working operations very well.

2.3.4.2 **INSPECTION:**

1. In connection with receiving and unloading at site, and at the final storing place before assembling, the transformers shall be inspected carefully. External visible damages as dents, paint damage etc. may imply that the transformer has been subjected to careless handling during transport and/or re-loading, and a careful investigation is therefore justified.
2. After the arrival of the material at receiving points, before unloading, the condition of packing and of the visible parts should be checked and possible traces of leaks verified (condenser bushing). If necessary, appropriate statements and claims should be made.
3. Drums containing oil which have separately dispatched should be examined carefully for leaks or any sign of tampering. All dispatched drums are filled up to their capacity and any shortage should be reported.
4. Check immediately the gas pressure at the arrival. A positive indicates that the tank and the transformer components respectively are tight, and that the active part including the insulation materials is dry.
5. If there is no positive gas-pressure, transformer should be immediately filled with dry Nitrogen gas at a pressure of 0.17 kg/cm^2 (2.5 psi) without loss of time.
6. Otherwise, it should be checked if the core isolation is satisfactory and that accessories packed separately have not been damaged during transportation.

2.3.4.3 **UNLOADING:**

1. Whenever rollers/trolleys are supplied with transformer, movement of transformer at site is carried out by mounting these rollers / trolleys.

2. Alternatively for movement of transformer from loading bay to actual site of the equipment, skidding on greased rails etc can also be resorted to.

2.3.4.4 **STORING:**

1. Dismantled equipment and components are packed to the protected against normal handling and transport stresses. The instructions for lifting given on the packages, must be complied with to avoid damages.
2. Goods stored outdoors must not be placed directly on the ground, and should be covered carefully with tarpaulin or similar materials.
3. Oil drum should be stored in horizontal (lying) position with both the bungs also in horizontal position.

2.3.4.5 **LIFTING:**

1. Lifting devices on the transformer tank are dimensioned of lifting of the complete transformer filled with oil. The positioning of the lifting devices, permissible lifting angles, minimum height to crane hook and transformer weight, appear from the OGA drawings. Check at lifting of compete transformer that the lifting wires/ropes are not in contact with bushing or other components on the cover.
2. For lifting with hydraulic jacks, the transformer is provided with jacking pads dimensioned for lifting of complete transformer filled with oil. The position of the pads appear on the OGA drawings.

2.3.4.6 **CHECK POINTS BEFORE STARTING AND DURING ERECTION:**

a. Check points before starting erection.

1. Conditions of leads
2. Bracing, clamping of leads
3. Connections
4. Tap changer checks
5. General conditions of insulation
6. Core check that it has not moved in transit.
7. Core-ground; this is checked with the megger after removing earth connection
8. CTs, including the secondary leads and their passage through metal parts
9. Check that shipping frame for bushings have been removed.
10. Check that coil position has not moved in transit

11. Check for dirt, metal swarf, moisture
12. Check that the bushing leads set without being too close to ground or other points of different potential.

b. Check-points during erection:

By means of the part list and the transformer / reactor OGA, the assembling of a fully completed transformer is carried out according to the following instructions. The following precautions are to be taken:

1. Fire-fighting equipment shall be available at the oil-treatment equipment as well as at work on and adjacent to the transformer.
2. Welding work on or adjacent to the transformer shall be avoided, but if this is not possible, the work shall be supervised by fire-protection personnel.
3. Smoking on or near the transformer shall not be allowed.
4. Transformer tank, control cabinet etc, as well as assembling and oil-treatment equipment shall be connected with the permanent earthing system of the station
5. Check that there is no overpressure in the transformer when blanking plates or connection lids are to be opened.
6. All loose objects, tools, screws, nuts etc. shall be removed from the transformer cover before opening the connection and blanking lids.
7. All loose objects (tools, pencils, spectacles etc.) shall be removed from the boiler- suit pockets etc. before starting the work through man-holes.
8. Tools to be used inside the transformer e.g. for tightening of screws-joint-shall be fastened to the wrist or another fixed point by means of cotton tape or string.
9. Tools with loose sleeves and tools with catches must not be used at work inside the transformer.
10. Greatest possible cleanliness shall be observed at work inside the transformer, and at handling of part to be mounted inside the transformer.
11. Fibrous cleaning materials should not be used as it can deteriorate oil when mixed with it.
12. All components dispatched separately should be cleaned inside and outside before being fitted.

13. A Transformer is best protected for damp hazard by circulating warm, dry, de-aerated oil through it until it temperature is 5˚ C to 10˚ C above ambient. This should be done before allowing external excess to the interior of the tank. The warm oil should be circulated all the time transformer is open to atmosphere.
14. Oil pump & all joints in the oil pipe work should be air tight to avoid entrance of air through leakage joints.
15. The active part (core and winding) should be exposed to the surrounding air as short time as possible. Open therefore only one blanking plate or connection lid at a time for remounting of bushing, valves etc.
16. Objects which-despite all precaution are dropped inside transformer / reator, must absolutely be brought up form the equipment.
17. Check that the oxygen content inside the transformer tank is minimum 20% if a person is to enter the tank.

2.3.4.7 **ASSEMBLY:**

Assembly of wheels Bushing Valves, cooling device, Oil conservator, Pilol Flanges, Blanking plates and accessories like cooling fans, pumps, OLTC and components for supervision and control oil level indicator, flow indicators, gauges, Buchholz relay, PRV, thermometers etc. are assembled according to leaflet / description valid for the components.

2.3.4.8 **OIL FILLING:**

The following procedure is recommended.

1. Close and blank the valve to isolate the conservator from main tank. Fill the oil in transformer under vacuum up to Buchholz level as per instructions given else where.
2. After filling the oil in transformer and breaking the vacuum, oil can be filled in the conservator either through reactor or by drain valve.
3. Remove the inspection cover (ii) provided on the side of the conservator and check the air cell assuring that it is inflated. The air must remain in fully inflated condition during oil filling operation. If the air cell is found deflated fit the inspection cover and inflate the air cell with dry air / nitrogen gas to 0.035 kg/sq.cm max. A gauge may be put by removing plug. After filling close these connections.
4. Remove air release plugs provided on top of the conservator.
5. Slowly pump the oil through main reactor / drain valve. Temporarily stop filling operation when oil starts coming from opening after ensuring

that no air bubbles come out through these air release holes. Fit the two air release plugs.

6. Continue oil filling till oil start coming from air release plug stop oil after ensuring that no air bubbles come out. Fit the plug.
7. Now release the air pressure held inside the air cell from point and continue oil filling until magnetic oil gauge indicates 35 deg. C level.
8. Remove oil pump and connect air cell to breather from point. Also remove pressure gauge and put plug.
9. The system is now properly filled. Air release plugs are fitted in normal operation.

2.3.4.9 **EQUIPMENT FOR OIL-FILLING UNDER VACUUM**

1. High-vacuum 2 storage oil filtration plant provided with thermostat-controlled oil heaters and vacuum-proof hoses with dependent vacuum pumping system for tank evacuation. Capacity: 10KL / Hour
2. Oil-storage tanks provided with silica-gel breathers and inlet / outlet valves for oil circulation. Recommended capacity 40KL
3. Vacuum gauges provided in filtration plant.
4. Equipment for measurement of electric strength (BDV) of oil - 100 kv set.
5. Equipment for moisture content of oil.
6. Equipment for measurement of Resistivity and Tan delta at 90 C.
7. Transparent vacuum-proof tubes for checking of oil-level during oil filling.
8. Valves, fitting, gaskets etc.
9. Dry nitrogen cylinders.

2.3.4.10 **COMMISSIONING:**

Testing after Assembly of the Transformer

After the transformer has been assembled at site, it shall be tested in order to check that it has not been damaged during transport and assembly to such an extent that its future operation will be at risk. Regarding the performance of the test, refer to the testing method as per standards. The results of the test shall be documented.

2.3.4.11 **COMMISSIONING CHECKS**

A. CHECK LIST

Sl.No.	Description

01	Breather Silica gel (Blue when dry)
02	Oil in the Breather housing cup
03	All valves for their correct opening and closing sequence
04	Oil level in conservator tank
05	Oil in cooling system
06	Oil level in bushings
07	Release air, wherever necessary
08	Cooling accessories (Pump motors, Fan motors etc.) for direction and O/L setting
09	Buchholz, oil level indicator, pressure gauges, thermometer, Temp. indicators etc
10	Neutral Earthing
11	Earth Resistance of Electrodes
12	Earthing of bushing test tap
13	Check oil leakage for 24 hrs
14	Check Auxiliary Circuit Voltage (415 V)
15	Calibration of OTI/WTI with hot oil
16	Check Working of WTI/RTD repeaters at control room
17	IR of core to earth
18	Di-Electric strength of oil PPM & Chemical analysis specific gravity test
19	IR tests on windings to earth and between winding
20	Phase sequence test & Vector group check
21	Continuity test
22	No load voltage ratio on all tap position
23	Winding resistance in all taps
24	Tap changing at 415 V, 3 phase, 50 Hz supply in all three phases
25	TAN-Delta test if quality check list calls for
26	Dew point check for N2 Gas at the time of oil filling

B. INSULATION RESISTANCE TEST

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

Note :-

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

C. OIL CHARACTERISTICS.

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

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

D. TESTS ON CT:

1. Ratio
2. Polarity

3. Magnetizing current
4. IR Value

E. POTENTIAL TRANSFORMER TESTS:

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

F. ON LOAD TAP CHANGER

Sl.No	Description	Date	Observation	Remarks
1	Visual Inspection of equipment.			
2	Hand operation on II taps.			
3	Complete wiring of the circuits			
4	Limit Switch			
5	Over running device			
6	Remote Panel Wiring.			
7	Overload Device of Driving Motor.			
8	Local Operation (Electrical)			
9	Remote Operation (Electrical)			
10	Tap Position Indicator.			
11	Step by step contractor			
12	Out of Step Relay.			

Note:

1) While operating the mechanism on Electrical Control, check once again limit switches, step by step contractor, over running device etc. for their actual operation and prove that they are functioning properly.
2) For More details Please refer Respective Manuals.

2.3.5.0 **GUIDELINES FOR ERECTION OF HT SWITCHGEAR PANELS:**

2.3.5.1 **Erection**

1. The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing works are to be completed.
2. All the panels/board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.
3. All the boards will be delivered in sections. Necessary interconnection of bus bar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.

2.3.5.2 **THE FOLLOWING POINTS SHALL BE CHECKED UP DURING ERECTION**

1. Layout of foundation channels.
2. Floor level covered by the panel with respect to main floor level.
3. Location and serial no. of panels.
4. Positioning of panels.
5. Verticality of switchgear panels within the limit specified.
6. Freeness of Breaker Truck and modules in housing and its manual operation.
7. Earthing of panels and breaker truck to station earth.
8. Lugs for termination of HT and LT cables.
9. Mounting and fixing arrangements of Bus bars.
10. Tightening of Bus bar jointing bolts as specified.
11. Clearance between :
    a. Phase to Phase
    b. Phase to earth
12. Minimum clearance for:
    a. Breaker, Truck and modules withdrawal
    b. Distance required for maintenance work
13. Check the operation of:
    a. Remote control
    b. 2.Various required - closing / tripping / alarm / indications / interlocks
14. Installation position of insts and relays Operation of relays and meters by

secondary injection.

15. AC/DC supplies for panel final relay settings as per customer requirements.
16. Tightness of terminal connections for HT & LT connections.
17. Opening operation of breaker, manually and electrically.
18. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

2.3.5.3 **HT SWITCHGEAR TESTS**

1. IR test
2. HV one minute P.F. test checking of oil level
3. Measurement of contact resistance for HT breakers
4. Test to prove inter changeability of similar parts (including breaker module)
5. Testing of relays as per supplier's commissioning manual
6. Testing and calibration of all meters.
7. Operation of all relays by secondary injection method
8. Testing of CT polarities and CT ratio by primary injection test.
9. Measurement of knee point voltage and secondary resistance for CTs used for differential protection.
10. IR and voltage ratio test for PTs
11. Functional test of all circuit components for each panel / feeder.
12. Test to prove closing/tripping operation at minimum and maximum specified voltage in test and service position.
13. Check for draw out test and service position of breakers for all feeders.
14. Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker.
15. HV test on vacuum interrupters (for VCBs)
16. Check for pressure of SF6 gas and air (for SF6).

2.3.6.0 **GUIDELINES FOR CABLE LAYING:**

1. In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.
2. In case of multi-core cables of diameter up to 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.

3. Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.
4. GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends. GI conduits shall be provided by BHEL.
5. In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy duty PVC pipes shall be provided**.** PVC pipes shall be provided by BHEL.
6. Entry of cables through trenches/tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.
7. Cables laid exposed in racks/trays and routed through trenches/tunnels/basements etc. to individual drive/control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment in the panels located, above trenches, tunnels or basement.
8. All cables routed along walls or in equipment rooms shall be protected by means of laying them through GI pipes or by providing sheet metal covers up to a height of 2000 mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.
9. Tray covers shall not be provided for the cable trays within trenches, tunnels and basements. Non-perforated type sheet steel covers shall be provided for the trays in the areas susceptible to accumulation of coal dust/atmospheric abuses etc.
10. Cable trays shall be supported on ISA 50x50x6mm MS/GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas.
11. Wherever direct heat radiation exists, heat isolating barriers (subject to customers approval), for cabling system shall be adopted.
12. For 415V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded/exposed GI conduits or rigid PVC pipes as applicable.
13. If required, a few numbers of cables in exceptional areas may be directly buried into the earth.

14. Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth as decided by Engineers.
15. At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.
16. In corrosive atmosphere, PVC conduits shall be used for cables.
17. Single core cables, when pulled individually shall be taken through PVC pipes only.
18. Laying and installation of power, control and special cables shall generally conform to IS : 1255
19. The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
20. In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks/trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.
21. Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.
22. Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255.
23. All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor / wall crossings, every 25m spacing for straight runs or as specified by Engineer for easy identification of cable.
24. When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.
25. Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material. Trefoil clamps shall be provided by BHEL

26. Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacing not less than one cable diameter of bigger diameter cable.

27. All 1100 V grade multicore power cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanised MS saddles / aluminium strips / nylon cable ties. Cables above 35mm diameter shall be clamped individually.

28. Control cables shall be laid touching each other and wherever required may be taken in two layers. All control cables shall be clamped with a common clamp/tie.

29. Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:

    A. HT cables shall be laid in the top tier(s)

    B. LT power cables to be laid in the tray(s) below the HT cable trays.

    C. LT control cables to be laid in the Tray(s) next below to the LT power cable (trays)

    D. Special control cables including screened control cables to be laid in the bottom most tray(s).

30. For vertical formations, the trays closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed. However, where there is no clear distinction of bottom / top trays, the order convenient for linking the horizontal and vertical formations shall be followed.

31. When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses 29 & 30 indicated above, the following rules shall override the criteria. However, prior approval of the Engineer will be required. In hierarchical order:

    A. Control cables are mixed up with the special control cables with clear minimum gap of 100 mm between them.

    B. LT power cables are mixed up with control cable with clear minimum gap of 150 mm between them.

    C. LT power cables are mixed up with HT power cables with clear minimum gap of 200 mm between them.

    D. LT power cables are mixed up with special control cables with clear minimum gap of 200 mm between them.

32. In case of duplicate feeders to essential loads, the respective cables shall be laid through separate raceways. Alternatively, such cables shall be laid on the opposite sides of a trench / tunnel / basement.

33. For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanized.

34. For laying cables along concrete walls, ceilings etc. The cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 6 mm thickness.

35. To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.

36. No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits/pipes in trefoil formation only.

37. In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.

38. Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.

39. Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.

40. SUPPORT SPACINGS & CLAMPINGS
Support spacing and clamping suitably provided and as required

41. LAYING OF CABLES DIRECTLY BURIED IN GROUND
Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.

42. SUPPORT SPACINGS & CLAMPINGS

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

43. OTHER CLAMPS

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

44. CABLE TERMINATION AND JOINTING

a. When the equipment are provided with undrilled gland plates for cable/conduit entry into the equipment, drilling and cutting on the gland

plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before drilling holes. Cutting shall not be allowed.

b. Termination of cables shall be done as per termination drawings & interconnection diagrams furnished to the contractor. Looping of cores/wires at terminals as shown in interconnection diagrams is to be done.

c. All cable entries in the equipment shall be sealed after glanding the cables.

d. Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core/conductor.

e. Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals.

f. End sealing / termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.

g. Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs.

h. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.

i. Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint. The straight through jointing kits for LT power/control cables as required shall be arranged by the contractor at their cost. The make shall subject to approval of BHEL's Engineer.

j. Termination and jointing shall generally conform to the requirements of IS: 1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.

45. **TESTING OF CABLES:**

i. The contractor shall submit to the Engineer a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist.

ii. Testing and electrical measurement of cable installations shall conform to IS : 1255

iii. Prior to installation, cables shall be tested for :
   a) Continuity of conductors
   b) Insulation resistance between conductors & earth
   c) Insulation resistance between conductors.

iv. After installation cables shall be tested for :
   a) Insulation resistance between conductors & iron
   b) Insulation resistance between conductors & earth
   c) Conductor resistance
   d) Capacitance between conductors & earth (for cables above 7C.1.3KV grade)
   e) DC high voltage test (for LT power cables of higher sizes interconnecting PCCs & MCC)
   f) Absence of cross phasing
   g) Firmness of terminations

2.3.7.0 **TESTS FOR THE EQUIPMENT ERECTED BY OTHER/MECHANICAL CONTRACTOR** The tests to be carried out on the equipment at which are normally being erected by Mechanical contractor.

2.3.7.1 **GENERATOR**

Generator set with all auxiliaries and controls shall be assembled and tested to verify compliance with the guaranteed technical particulars and for satisfactory performance. Relevant standards shall be followed as guideline for testing. All the tests shall be witnessed by customer or its representative. The commissioning tests shall be carried out at site under normal service conditions.

Following tests shall be carried out on the generators:

1. Insulation resistance test and determination of polarization index value of:
   – Generator
   – Exciter
   – Resistance temperature detectors
2. Dielectric test
3. No load characteristics
4. Short circuit characteristics

5. Temperature rise at rated voltage, current, power factor and frequency.
6. Calculation of efficiency
7. Phase sequence / voltage balance / current balance checks.
8. Instantaneous short circuit test (Optional).
9. Response of voltage and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively.
10. Measurement of DC resistance of winding
11. Inter turn insulation test of stator winding with induced voltage 130% of rated value for 5 minutes (if applicable).
12. Measurement of shaft voltage.
13. Measurement of Stator and bearing temp. during load run.
14. Tan Delta test for generator bushing (If required).

2.3.7.2 **AC MOTORS**

1. IR test of stator and rotor windings.
2. Heating of both windings up to the permissible temp.
3. Checking/testing of associated switchboard, cables, relays / meter interlockings as mentioned in relevant chapters are completed.
4. Tightness of cable connection.
5. Winding resistance measurement of stator and rotor.
6. Checking continuity of winding.
7. Checking tightness of earth connections.
8. Checking space heaters and carryout heating of winding (if required)
9. Checking direction of rotation in decoupled condition during kick start
10. Measurement of no load current for all phases
11. Measurement of temperature of body during no load and load conditions.
12. Check for tripping of motor from local/remote switches and from.
13. Checking of vibration (if required).
14. Checking of noise level (if required)
15. Measurement of stator and bearing temperatures during load running (if applicable) for every half an hour interval till saturation comes
16. Checking operation of speed switch (if there)

17. Checking of polarisation index of stator winding, R10/R1 by motorised megger (The value should not be less than 2.0) R60/10 absorption coefficient shall not be less than 1.5
18. Dielectric test

2.3.7.3 **DC MOTORS**

1. IR measurement and heating the winding as per heating curve.
2. Check for earth connection
3. Winding resistance for field and armature.
4. Check running of drive at minimum and maximum specified.
5. Check auto start of drive on failure of AC supply (if applicable)
6. Check operation of overload relay.
7. Measure load currents and no load currents (if possible)
8. Check direction of rotation.
9. Check continuity of winding.
10. Measurement of RPM.

2.3.8.0 **CODES AND STANDARDS**

1. All equipment and materials shall be designed, manufactures and tested in accordance with the latest applicable Indian Standards (IS) except where modified and / or supplemented by this specification.

2. Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

IS The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to dates, relevant IS codes of Practice and Indian Electricity Act. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding. A list of applicable standards is given below for reference.

IS 3043 Code of practice for earthing

IS 3072 Installation and maintenance of switchgear

IS 5133 Box for enclosure of electrical equipment

IS 5216 Guide for safety procedure and practice in electrical work

IS 13947 Degree of protection provided by enclosures for low voltage

switchgear and control gear.

IS 5216 Guide for safety procedures and practices in electrical works.

IS 800 Code of practice for use of structural steel.

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

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

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

2.3.9.0 **TECHNICAL REQUIREMENT FOR ITEMS SUPPLIED BY THE CONTRACTOR.**

2.3.9.1 **GENERAL**

1. Equipment and material supplied shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.
2. Equipment and materials furnished shall be complete and operative in add details.
3. All the accessories, fittings, supports, anchor bolts etc., which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.
4. All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.
5. Samples of all items shall be made available for purchaser's approval prior to supply of item to site.

2.3.9.2 **FERRULES**

1. Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter.
2. Ferrules shall be of plastic material.
3. Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave colouring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600

mm.

4. Ferrules shall be interlocking type in such a way that the interlocked ferrules take the shape of tube with complete ferrule number appearing in a straight line.

2.3.9.3 **TAGS**

1. Cables shall be provided with cable number tags for identification.
2. Cable tags shall be of durable fibre, aluminium or stainless steel sheets.
3. Cable number shall be engraved type in case of aluminium or stainless steel tags, and printed type in case of fibre sheet.
4. Tags shall be durable quality of size 60mm x 12mm with holes at both ends.
5. Samples of tags shall be approved by BHEL Engineer before delivery.
6. Tags shall be provided with non-corrosive wire of sufficient strength for taggings.

2.3.9.4 **FIRE STOP CABLE SEALING SYSTEM (AS APPLICABLE)**

Fire stop cable sealing system shall have two (2) hours fire protection rating suitable for sealing both vertical & horizontal cable penetrations. The sealing compound in conjunction with mineral wool shall form effective fire seals. The sealing compound shall have special property to allow for short circuit conditions. **GPG fire stop sealing compo** or equivalent sealing compound shall be used.

2.3.10 **GUIDELINES FOR ERECTION OF GI PIPES , SUPPORTS & ACCESSORIES**

1. For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.

2. For equipment and devices having GI conduit entry arrangement other than standard GI conduit adopter, adopters shall be provided as required to enable the GI conduit to be properly terminated, between conduit end and motor T.B.

3. GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.

4. The entire GI conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the GI pipes entering them.

5. Bends of GI pipes / conduits shall be made without causing damage to the pipes/conduits.

6. Occupancy of conduits shall not be greater than 40%.
7. The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminum or galvanized steel.
8. Transportation and storage of cable drums shall generally conform to the requirements of IS: 1255.
9. All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.
10. The cable drums shall be transported on wheels to the place of work.

Note: *The tests specified above for all the electrical equipment are not exhaustive. Any other pre-commissioning and field tests not included in the above list but necessary as per relevant standards, Electricity rules, code of practice and instructed by the manufacturer of the equipment shall also have to be carried if deemed necessary shall be carried out as per requirement either within the quoted rates / price or at additional cost. Decision of Engineer in charge will be the final regarding additional cost for testing. The contractor shall take the full responsibility of testing, commissioning, trial run and successful operation of the equipment under overall.*



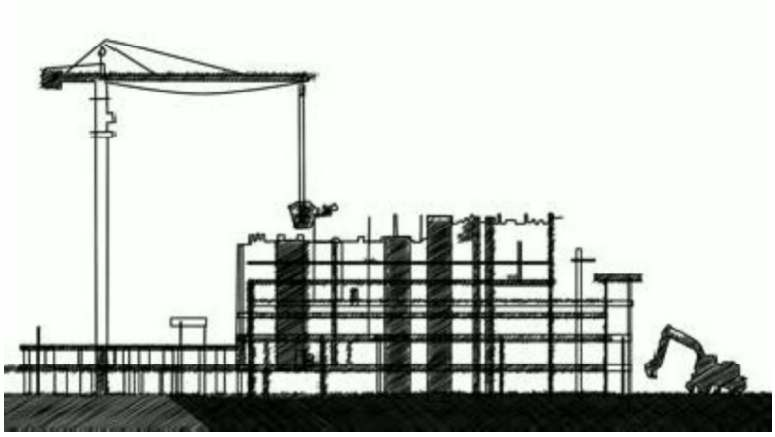
HEALTH, SAFETY and ENVIRONMENT PLAN

for

SITE OPERATIONS

by

SUB-CONTRACTORS



POWER SECTOR

HSE PLAN FOR SITE OPRATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START

SIGNING OF MOU
Agree to comply to HSE requirement- Statutory and BHEL's

PLAN

HSE ORGANISATION	
Manpower • 1 (one) safety officer for every 500 workers or part thereof • 1(one) safety-steward/ supervisor for every 100 workers **Qualification** As per Cl. 7.1	**HSE Roles and responsibilities** • Site In-charge- As per clause 7.2.1 • Safety officer- As per clause 7.2.2

HSE Planning
for Man, Machinery/Equipment/Tools & Tackles

PROVIDE

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

TRAIN

HSE TRAINING , AWARENESS & PROMOTION	
Training • Induction training • Height work and other critical areas • Tool Box talk & Pep Talk	**Awareness & Promotion** • Signage • Poster • Banner • Competition • Awards

COMMUNICATE

HSE COMMUNICATION	
Incident Reporting • Accident- Fatal & Major • Property damage • Near Miss	**Event Reporting** • Celebrations • Training • Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation (More than 4 metres)

SAFETY DURING WORK EXECUTION

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

HOUSE KEEPING

WASTE MANGEMENT

TRAFFIC MANAGEMENT

ENVIRONMENTAL CONTROL

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

CHECKS

HSE AUDITS & INSPECTION

- Daily Checks
- Inspection of PPEs
- Inspection of T& Ps
- Inspection of Cranes & Winches
- Inspection of Height work
- Inspection of Welding and Gas cutting
- Inspection of elevators etc.

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

For repeated violation by the same person, the penalty would be double of the previous penalty

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

REVISION HISTORY SHEET

Date	Revision No.	Details of Changes	Reason	Prepared	Reviewed	Approved
12.08.2014	00	First Issue	First Issue	S. B. Jayant, Dy Manager-FQA & Safety	A. K. Sinha, GM-FQA & Safety	Anuj Bhatnagar, ED-FQA & Safety
20.01.2020	01	Formats added: **HSEP:14-F30 – Monthly HSE Planning & Review** (Page 11, Clause 8.0 - updated) HSEP:14-F13E-Excavation Inspection Format (part of F30)) HSEP:14-F32B – Job Safety Analysis Format (part of F30) **HSEP:14-F31A – Daily HSE Reporting** (Page 18, Clause 10.3 – added) **HSEP:14-F33 – HSE Performance Evaluation** (Page 31, Clause 13 – revised)	IOM No. **PSHQHSE/MONREP/02** Dated 08-Jan-2020	Rohit Kumar	Santosh Nair, GM (MSX & HSE)	

Sr. No.	Description	Page No.
1.0	PURPOSE	4
2.0	SCOPE	4
3.0	OBJECTIVES AND TARGETS	4
4.0	HEALTH, SAFETY & ENVIRONMENT POLICY	5
5.0	MEMORANDUM OF UNDERSTANDING	6
6.0	TERMS & DEFINITIONS	7
7.0	HSE ORGANIZATION	8
7.1	QUALIFICATION FOR HSE PERSONNEL	8
7.2	RESPONSIBILITIES	9
8.0	PLANNING BY SUBCONTRACTOR	11
8.1	MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS	11
8.2	MOBILISATION OF MANPOWER BY SUBCONTRACTOR	11
8.3	PROVISION OF PPEs	12
8.4	ARRANGEMENT OF INFRASTRUCTURE	13
9.0	HSE TRAINING & AWARENESS	16
9.1	HSE INDUCTION TRAINING	16
9.2	HSE TOOLBOX TALK	17
9.3	TRAINING ON HEIGHT WORK	17
9.4	HSE TRAINING DURING PROJECT EXECUTION	17

9.5	HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC	18
10.0	HSE COMMUNICATION	18
10.1	INCIDENT REPORTING	18
10.2	HSE EVENT REPORTING	18
11.0	OPERATIONAL CONTROL	19
11.1	HSE ACTIVITIES	19
11.2	WORK PERMIT SYSTEM	20
11.3	SAFETY DURING WORK EXECUTION	20
11.4	ENVIRONMENTAL CONTROL	24
11.5	HOUSEKEEPING	24
11.6	WASTE MANAGEMENT	25
11.7	TRAFFIC MANAGEMENT SYSTEM	26
11.8	EMERGENCY PREPAREDNESS AND RESPONSE	28
12.0	HSE INSPECTION	29
12.1	DAILY HSE CHECKS	29
12.2	INSPECTION OF PPE	29
12.3	INSPECTION OF T&Ps	30
12.4	INSPECTION OF CRANES AND WINCHES	30
12.5	INSPECTION ON HEIGHT WORKING	30
12.6	INSPECTION ON WELDING AND GAS CUTTING OPERATION	30

12.7	INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES	31
12.8	INSPECTION OF ELEVATOR	31
12.9	INSPECTION OF EXCAVATION ACTIVITIES	31
13.0	HSE PERFORMANCE	31
14.0	HSE PENALTIES	32
15.0	OTHER REQUIREMENTS	32
16.0	NON COMPLIANCE	33
17.0	HSE AUDIT/INSPECTION	34
18.0	MONTHLY HSE REVIEW MEETING	34
19.0	FORMATS USED	34
20.0	Annexures	36

1.0 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.

1.3 Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.

1.4 In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

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

3.0 OBJECTIVES AND TARGETS

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

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

HSE TARGETS

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

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Health, Safety & Environment Policy of BHEL

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

sd/-

CMD, BHEL

5.0 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_____shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.

In addition to this, M/S_____shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s_____shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

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

Name :

Place & Date:

6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

Work- related or natural event(s) in which an injury, or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

6.1.2 NEAR MISS

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as "Near-Miss".

6.1.3 MAN-HOURS WORKED

The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labours. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

6.1.4 FIRST AID CASES

First aids are 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.

6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

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

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

Injury Cases:
These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

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

6.1.9 SEVERITY RATE

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

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

6.1.10 INCIDENCE RATE

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

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

7.0 HSE ORGANISATION

Number of safety officers:
The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

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

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

2	Safety-Steward/ Safety-Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years

7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

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

7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR

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

8.0 PLANNING BY SUBCONTRACTOR

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

8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- 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.

- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:

  - Mobile cranes.
  - Side Booms.
  - Forklifts.
  - Grinding machine.
  - Drilling machine.
  - Air compressors.
  - Welding machine.
  - Generator sets.
  - Dump Trucks.
  - Excavators.
  - Dozers
  - Grit Blasting Equipment.
  - Hand tools.

- 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.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- 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.
- Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

8.3 PROVISION OF PPEs

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

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

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

Relevant is-codes for personal protection

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

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

- 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
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
2. Safety staff: Green or white with green band
3. Electrician: Red
4. Others including visitors: White

- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
- The issuing agency shall maintain register for issue and receipt of PPEs.
- The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

8.4.3 LATRINES AND URINALS

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

8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

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

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

8.4.5.2 FIRST AIDER

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

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

- The 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.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

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

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

a. Height workers
b. Drivers/crane operators/riggers

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

8.4.6 PROVISION OF CANTEEN FACILITY

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

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

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

8.4.8 PROVISION OF EMERGENCY VEHICLE

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

8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores.

8.4.10 SCRAPYARD

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

8.4.11 ILLUMINATION

- The 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.

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

S. No.		Location	Illumination (Lux)
A.	**Construction Area**		
1.		Outdoor areas like store yards, entrance and exit roads	20
2.		Platforms	50
3.		Entrances, corridors and stairs	100
4.		General illumination of work area	150
5.		Rough work like fabrication, assembly of major items	150
6.		Medium work like assembly of small machined parts rough measurements etc.	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

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

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

9.0 HSE TRAINING& AWARENESS

9.1 HSE INDUCTION TRAINING

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

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

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

- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

9.2 HSE TOOLBOX TALK

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

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

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

- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.

- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

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

9.5.1 Display of HSE posters and banners

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

9.5.2 Display of HSE signage

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

9.5.3 Competition on HSE and award

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

9.5.4 HSE awareness programme

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

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

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

10.2 HSE EVENT REPORTING

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

10.3 DAILY HSE ACTIVITY REPORTING

Daily HSE activities shall be reported by subcontractor to BHEL as per Format No. HSEP:14-F31A

11.0 OPERATIONAL CONTROL

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

LIST OF OCPs

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

11.1 HSE ACTIVITIES

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

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

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

11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
  a. Height working above 2 metres
  b. Hot working at height
  c. Confined space
  d. Radiography
  e. Excavation more than 4 meter depth
  f. Heavy lifting above 50 ton
  Refer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

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

11.3.1 WELDING SAFETY

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

11.3.2 RIGGING

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

11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP
Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
- All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..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.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.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.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource ad their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.

- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist' and the report is to be submitted to BHEL safety officer
- 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
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- 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.
- 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.
- 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.
- Emergency contacts nos must be displayed at prominent locations
- 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.

11.3.9 SCAFFOLDING

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

11.3.10 **WORK AT HEIGHT**:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.

- Wherever necessary, life-line (pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

11.3.13 LADDER SAFETY

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

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.

- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

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

11.4 ENVIRONMENTAL CONTROL

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. 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.

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).

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

All subcontractors shall be responsible for the cleanliness of their own areas.

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.
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, keeping good relation with local populace etc.
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.

11.5 HOUSEKEEPING

- Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings has to be done by

subcontractor within quoted rate, on daily basis by an identified group. 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 contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- 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.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

11.6 WASTE MANAGEMENT

Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

11.6.1 BINS AT WORK PLACE

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

11.6.2 STORAGE AND COLLECTION

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

11.6.3 SEGREGATION

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

11.6.4 DISPOSAL

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

11.6.5 WARNING AND SIGNS

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

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

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

11.7.4 DAILY CHECK BY DRIVER

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

11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
- Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- On no account 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.
- Warning signs shall be displayed during transportation of material.
  All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 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.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- 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.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.

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

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS 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 etc. as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety 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:

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

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

12.2 INSPECTION OF PPE

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

12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- The T&Ps which require third party inspection shall be checked for its validity during inspection. The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

12.4 INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

12.5 INSPECTION ON HEIGHT WORKING

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

12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

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

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

12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

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

12.8 INSPECTION OF ELEVATOR

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

12.9 INSPECTION OF EXCAVATION

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

13.0 HSE PERFORMANCE

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

14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- 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.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- 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 at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- 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.
- 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.
- 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.
- 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.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.

- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

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

- Legend:-

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

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

Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

17.0 HSE AUDIT/INSPECTION

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

18.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting,its root cause and Corrective action and Preventive action. The agenda is given below:
  - Implementation of earlier MOM
  - HSE performance
  - HSE inspection
  - HSE audit and CAPA
  - HSE training
  - Health check-up camp
  - HSE planning for the erection and commissioning and installation activities in the coming month
  - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

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

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

20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,

(1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

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

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.

(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT:_____ SUBCONTRACTOR:_____

DATE : _____ OWNER :_____

INSPECTION BY:_____

Note : write 'NA' wherever the items is not applicable

Item	Yes	No	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNELPROTECTIVEEQUIPTMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				

Angle + 70^0 from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				

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

ANNEXURE 03

REFERENCES

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

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

(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 20030	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing

ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS

बी एच ई एल BHEL	**POWER SECTOR** **INSPECTION OF FIRST AID BOX**	FORMAT NO: HSEP:14-F01 REV NO.: 00 PAGE NO. 01 OF 02

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

Number of employees on the site: -_____

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

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

Signature of Subcontractor's Site I/C:

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00 PAGE NO. 1 OF 02
	HEALTH CHECK UP	

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

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness
Personal History	

EXAMINATION		**OBSERVATION**	
General Physical Examination			
Height	:		
Weight	:		
BMI	:		
Built And nourishment	:		
Pallor	:		
Temperature	:		
Chest Expansion	:	Inspiration	Expansion
Lymph Node Enlargement	:		
Ear, Nose, Throat	:		
Ear	:		
Nose	:		
Throat	:		

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

Signature of the examining doctor

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

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

Sl No.	**Name**	**Designation**	**Organisation**	**Signature**

Signature of Training co-ordinator :

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

Name of Site :	
Sub-Contractors Name :	
Date :	

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

Signature of Site I/C of Subcontractor :

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

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

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

Signature of Site I/C of Subcontractor :

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

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

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

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

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

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

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

Signature of Site I/C of subcontractor:

BHEL	**POWER SECTOR** **INSPECTION OF CRANES AND WINCHES**	FORMAT NO: HSEP:14-F09 REV NO.: 00 PAGE NO. 01 OF 03

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

Crane Reg. No (Make/Model) _____

Name of Driver/Operator _____

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

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

WINCH

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

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

Signature of Site I/C of subcontractor :

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

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

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

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

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

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF WELDING AND GAS CUTTING**	FORMAT NO: HSEP:14-F11 REV NO.: 00 PAGE NO. 1 OF 02

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

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

	POWER SECTOR	FORMAT NO: HSEP:14-F11
	INSPECTION OF WELDING AND GAS CUTTING	REV NO.: 00 PAGE NO. 2 OF 02

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

Signature of Site I/C of subcontractor :

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

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

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

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

Signature of Site I/C of subcontractor :

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

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

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

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

	POWER SECTOR	FORMAT NO: **HSEP:14-F13E** REV NO.: 00 PAGE NO. 01 OF 01
	Inspection of Excavation	

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

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

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

Sub: MEMO for Penalty for non-compliances in Safety

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

Safety Area

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

Legend: -

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

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

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

_____

Penalty imposed:

1, Rate as per above chart_____

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

3. Total Penalty= 1. X 2. =_____

Signature:

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

Name_____ Name_____

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

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

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

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				

NAME				NAME OF MATERIAL / EQUIPMENT / PROPERTY	
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	ESTIMATED COST	ACTUAL COST
MARITAL STATUS		SINGLE / MARRIED			
OCCUPATION				NATURE OF DAMAGE	
PART OF BODY INJURED					
NATURE OF INJURY					
AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED				

ANALYSIS		
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT	
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?	
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?	
	DATE :	SIGNATURE OF SITE HSE COORDINATOR
17	COMMENTS OF HEAD / SOX	
	DATE:	SIGNATURE OF HEAD/SOX

	POWER SECTOR	FORMAT NO: **HSEP:14-F30** REV NO.: 00 PAGE NO. 01 OF 3
	Format for Monthly HSE Planning & Review	

Note: This is a template and can be modified in consultation with BHEL			
Name of the Site		**Name of the Subcontractor**	
Scope of Work		**Date**	
PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF.....			**PART-B: REVIEW ON .....**
SN.	**Description of HSE Activity & Formats**	**Plan & Targets for the month**	**Review**
1	Availability of First Aid Box at Required Places and Inspection thereof as per Format: F01	Areas 1. … …	
2	Health check-up as per Format: F02	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. …	
3	Induction training of newly joined workers as per Format: F03	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: F04	Locations of TBTs & No. of workers **1.** …	
5	PPE usage and issue as per Format: F06		
6	Inspection of T&Ps as per Format: F07	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: F08		
8	Inspection of Cranes & Winches as per Format: F09	List of Cranes & Winches & Nos. 1. …	
9	Inspection of Height Working as per Format: F10	Areas: 1. …	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. …	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. …	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. …	
13	Inspection of Excavation as per Format: F13E	**Locations:** **1. …**	

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

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

PLAN		**REVIEW**	
Agency Name: Sign: Date:	**BHEL** Name: Sign: Date:	**Agency** Name: Sign: Date:	**BHEL** Name: Sign: Date:

	POWER SECTOR	FORMAT NO: **HSEP:14-F31** A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

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

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

	POWER SECTOR	FORMAT NO: **HSEP:14-F32B** REV NO.: 00 PAGE NO. 01 OF 1
	Job Safety Analysis Format	

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS	PRECAUTIONS

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

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

SL	Parameter for Measurement	M/O	Wt	Supporting Documents
2m.1	Use of Lifting Permit as per requirement		1	Permit Records
2m.2	Use of Height Permit as per requirement		1	Permit Records
2m.3	Use of Hot Work Permit as per requirement		1	Permit Records
2m.4	Use of Excavation permit as per requirement		1	Permit Records
2m.5	Use of Confined space work permit as per requirement		1	Permit Records
2m.6	Use of Grating removal and safety net removal permit as per requirement		1	Permit Records
2m.7	Use of Lockout-Tag out permit as per requirement		1	Permit Records
2m.8	Use of Radiography permit as per requirement		1	Permit Records
2m.9	Use of Night/ Holiday Work Permit as per requirement		1	Permit Records
2m.10	Use of Any other Applicable Permit as per requirement		1	Permit Records
3a	Material safety data sheet(MSDS) available for all chemicals and displayed in usage and storage area?		1	Inspection/ non-conformity records
3b	Spillages of oil/concrete and other chemical is controlled and cleaned by proper method in case of spill?		1	Inspection/ non-conformity records
3c	Availability of adequate number of urinals in workplace and in elevations and maintained	M	1	
3d	Availability of rest rooms for workers at site	M	1	
3e	Availability of Drinking water facility at work spot		1	
3f	Hygienic Labour colony is provided for workers.		1	
4a	Is heavy/complex critical lifting permit obtained for heavy, complex materials before handling/erection activity?		1	Work Permit records
4b	Whether area below lifting activities barricaded		1	Inspection/ non-conformity records
4c	Availability of experienced rigging foreman		1	Experience details of rigging foreman
4d	Is agency is following proper storage and handling procedure as per manufacturer standard for all hazardous material?		1	Procedure for storage & handling
4e	Are oxygen and acetylene cylinders are transported to work place from storage area in trolleys		1	
5a	Whether all deep excavation has been protected by barrier		1	Inspection/ non-conformity records
5b	Sloping/benching & shoring provided for excavation as per requirement?		1	-do-
5c	Proper access and egress provided for excavations?		1	-do-
5d	Blasting is done in controlled manner?		2	-do-
6a	Whether Electrical booth is equipped with Co_2 fire extinguishers and fire buckets filled with sand?		2	Inspection/ non-conformity records
6b	Availability of Illumination lamp in electric booth?		1	-do-
6c	whether Caution Boards have been displayed?		1	-do-
6d	Usage of Metal Plug top for all hand power tools ?		1	-do-
6e	Usage of Insulated welding cables.		1	-do-
6f	Electrical Booth/Distribution Board to be covered by proper Canopy.		1	-do-
6g	Availability of functional & individual 30ma ELCB / RCCB and MCB for protection and conducting periodical check-up?		1	-do-
6h	Double earthing for panel boards and all machinery & proper earth pit with regular inspection available?		1	-do-
6i	Whether Electrician is qualified and experienced		1	Qualification & Experience records of electrician
6j	Availability and usage of Rubber hand gloves by electrician?		1	Inspection/ non-conformity records

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

Note:

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

SAFETY WORK CLEARANCE	Permit no.
Project:	Emergency Contact Nos:
Subcontractor:	

BURNING/WELDING /HOT WORK PERMIT

Area :_____Date:_____Time:_____

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

Name of Work Performing Contractor: _____

Name of Package In charge:_____Sign:_____Date:_____

Description of Work: _____

_____

Work Execution Date:_____Time Valid from:_____to _____

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

The following precautions are to be taken:

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

Name of Contractor Safety Officer:_____Sign:_____Date:_____Time: _____

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

Name:_____Sign:_____Date:_____Time:_____

Name of BHEL Safety Representative:_____Sign: _____

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

Name of Work Performing Authority:_____Sign:_____Date:_____Time:_____

Permit Cancellation:

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

Name of Work performing Authority:_____Sign:_____Date:_____Time:_____

Name of Site Engr. (Permit Requesting Authority):_____Sign:_____Date:_____Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____Sign:_____Date:_____Time: _____

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

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	**Emergency Contact Nos:**
Subcontractor:	

LIFTING ACTIVITY PERMIT

Area :_____Date:_____Time:_____

Name of Site Engineer (Permit Requesting Authority):_____Sign:. Name of Work

Performing Contractor: _____

Name of Package In charge:_____Sign:_____Date:_____

Description of Work: _____

_____

Work Execution Date:_____Time Valid from:_____to _____

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

The following precautions are to be taken:

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

Name of Contractor Safety Officer:_____Sign:_____Date:_____Time: _____

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

Name:_____Sign:_____Date:_____Time:_____

Name of BHEL Safety Representative:_____Sign: _____

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

Name of Work Performing Authority:_____Sign:_____Date:_____Time:_____

Permit Cancellation:

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

Name of Work performing Authority:_____Sign:_____Date:_____Time:_____

Name of Site Engr. (Permit Requesting Authority):_____Sign:_____Date:_____Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____Sign:_____Date:_____Time: _____

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

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

	SAFETY WORK CLEARANCE	**Permit no.**
	Project:	**Emergency Contact Nos:**
	Subcontractor:	

WORKING AT HEIGHT PERMIT

Area :_____Date:_____Time:_____

Name of Site Engineer (Permit Requesting Authority):_____Sign:. Name of Work

Performing Contractor: _____

Name of Package In charge:_____Sign:_____Date:_____

Description of Work: _____

_____

Work Execution Date:_____Time Valid from:_____to _____

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

The following precautions are to be taken:

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

Name of Contractor Safety Officer:_____Sign:_____Date:_____Time: _____

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

Name:_____Sign:_____Date:_____Time:_____

Name of BHEL Safety Representative:_____Sign: _____

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

Name of Work Performing Authority:_____Sign:_____Date:_____Time:_____

Permit Cancellation:

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

Name of Work performing Authority:_____Sign:_____Date:_____Time:_____

Name of Site Engr. (Permit Requesting Authority):_____Sign:_____Date:_____Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____Sign:_____Date:_____Time: _____

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

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**


बी एच ई एल
BHEL

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 [illegible])	15	68610.00	65280.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	31880.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	19920.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	28690.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	30130.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	25110.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	34580.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	14390.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18050.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	15940.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	20720.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10360.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	12750.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10420.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10200.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8440.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9560.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9560.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5210.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	5880.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5150.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4230.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	2910.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2180.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2180.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	680.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	370.00

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	650.00	640.00
31	FORK LIFT 3T	5	540.00	530.00

Annexure C2 DATE:31/08/202

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	27230.00	27230.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12160.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	59520.00
4	PORTAL CRANE, 360T	15	15630.00	14880.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	58630.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	72540.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	35420.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	22140.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	31880.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	33480.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	27900.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	38420.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	15990.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20060.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	17710.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	23020.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	11510.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14170.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11580.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11330.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9380.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	10620.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	10620.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5790.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6540.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5720.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4700.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3240.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2430.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2430.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	760.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	410.00

Annexure C2 DATE:31/08/202

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	720.00	710.00
31	FORK LIFT 3T	5	600.00	590.00

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1160
22	Air Blower (Flow: 20000 m^3/Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB DIAGONISTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 μΩ TO 20KΩ	3230
59	PMI Machine OLYMPUS make	3350
60	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	430

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360
96	Plasma Cutting Machine (With complete accessories)	310
97	JCB make DG Set 80 KVA	670
98	Diesel Generating Set 82.5 KVA	610
99	Portable Jacking Oil Pump	1080
100	Alloy Analyser	1770

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	7070
3	-DO- , WITH STORAGE TANK	8080
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1510
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	2020
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1410
9	Low Vacuum de-hydration unit	700
10	DIESEL GENERATING SET,250 KVA	1970
11	DIESEL GENERATING SET,25 KVA	560
12	VACUUM PUMP(ABSOLUTE V.C.)	600
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1210
14	ACID TRANSFER PUMP 20/50 T/HR	600
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	90
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4710
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1290
22	Air Blower (Flow: 20000 m^3/Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGONISTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 μΩ TO 20KΩ	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast - 9 metres (4X400 W)	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	510
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400
96	Plasma Cutting Machine (With complete accessories)	340
97	JCB make DG Set 80 KVA	740
98	Diesel Generating Set 82.5 KVA	680
99	Portable Jacking Oil Pump	1200
100	Alloy Analyser	1970

VOLUME-IA PART – II CHAPTER 6
LIST OF DRAWINGS

2.6. LIST OF DRAWINGS

2.6.1 THE FOLLOWING ENCLOSED DRAWINGS ARE FOR INFORMATION ONLY

Sl.No.	Drawing	No. of Sheets
1	Outline General Arrangement of 275 MVA Generator Transformer Drg.Nos.3-452-00-01120	**4**
2	Outline General Arrangement of 110 MVA Standby Maintenance Transformer Drg.Nos.1-46-000-50014	**1**
3	Outline General Arrangement of 70 MVA Transformer- Drg.No.1-456-00-51007	**1**
4	Layout of I.P. Bus duct- Drg.No.01791710001	**1**
5	Layout of S.P. Bus duct- Drg.No.02801710001	**1**

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

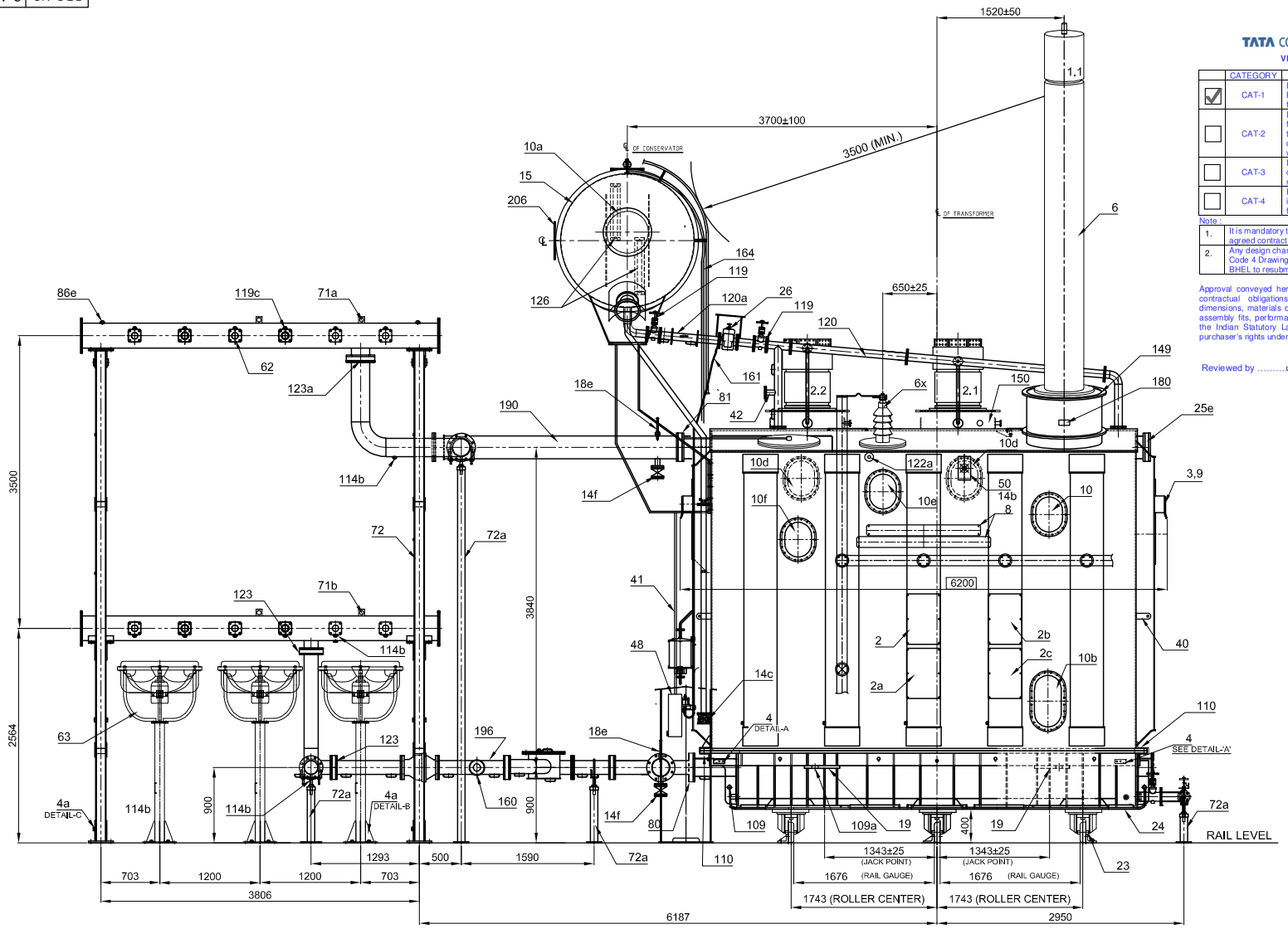
DRG. NO. 3 452 00 01120

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

SIGN.DATE

INVENTORY NO.



TATA CONSULTING ENGINEERS LIMITED

VENDOR DRAWING STATUS

	CATEGORY	DESCRIPTION
☑	CAT-1	Drawing/documents approved for final distribution. BHEL will proceed with manufacturing/ fabrication/construction.
☐	CAT-2	Drawing/documents cleared for manufacturing/ fabrication/construction subject to incorporating the comments given. BHEL to resubmit the drawing for Approval in Category – 1. Comments will be marked on the drawing documents.
☐	CAT-3	Drawing document will be corrected as per comment and resubmitted by BHEL for further review/checking.
☐	CAT-4	Drawing document of this category are for information only and not for approval. Information furnished on the document is noted.

Note :

1. It is mandatory to close documents with Code 2 & 3 to Code 1 in agreed contract period or 2 weeks, whichever is lower.
2. Any design changes / modification required to be carried out in Code 4 Drawings / Documents shall be the responsibility of BHEL. BHEL to resubmit reflecting the Design Changes for information.

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 supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchaser's rights under the contract.

Reviewed by .....S.S.Satish.....Date.....

REV	DATE	ALT.			
		CKD.			
		APPD.			
ZONE					

REV	DATE	ALT.			
		CKD.			
		APPD.			
ZONE					

REV	DATE	ALT.		
02	12.10.19	CKD.	GK/AK	-SD-
		APPD.	LK/AJ	-SD-
ZONE	COMMENTS INCORPORATED AS PER LETTER NO. 11403A-EL-VDT-231 DTD. 06.09.2019			

REV	DATE	ALT.		
01	31.07.19	CKD.	GK/AK	-SD-
		APPD.	LK/AJ	-SD-
ZONE	THE SIZING (RATING) OF THE GENERATOR TRANSFORMER IS AS PER THE ELECTRICAL SINGLE LINE DIAGRAM SUBMITTED BY BHEL PEM.			

TYPE OF PRODUCT	7 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER
PROJECT	2 X 660 MW UDANGUDI TPP-STAGE I
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BENGALURU
BHEL DRAWING/DOCUMENT NO	BP-DG-435-301-0001
ADDITIONAL INFORMATION	W.O.- 67022-A-512-01
	STATUS OF DRAWING "PR"
	DISTRIBUTION OF PRINTS
	TRE-1, TRM-3
PO. NO.	

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	- - - - -	COMP.SCALE-1:1

	NAME	SIGN	DATE
DRN.	SKC		29.11.2018
CHD.	GK/AK		03.12.2018
APPD.	LK/RKS		04.12.2018

TITLE/- OUTLINE GENERAL ARRANGEMENT (ELEVATION VIEW)

DRG. NO. 3 452 00 01120 REV. 02

SHEET 01 OF 04

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

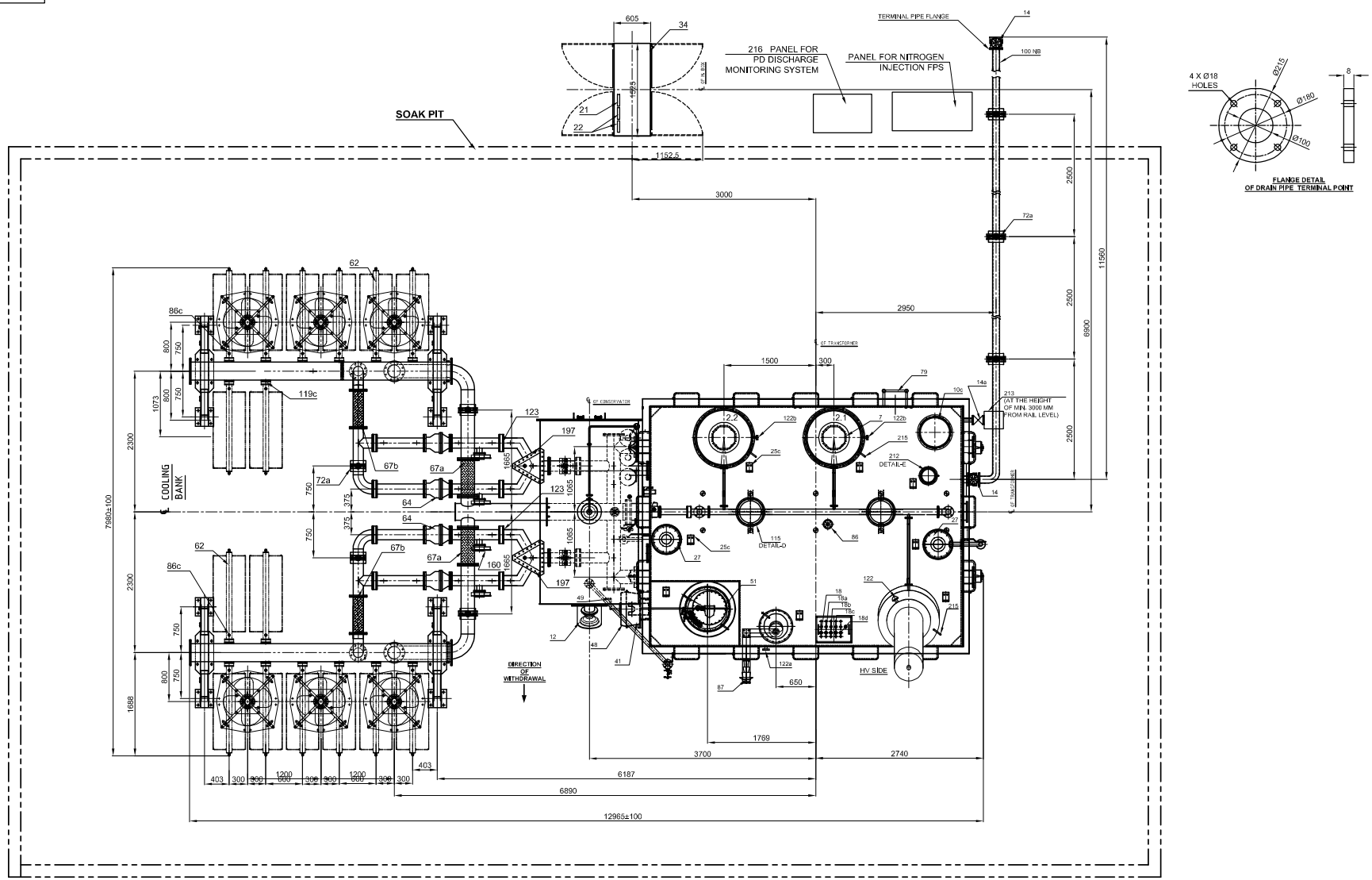
DRG. NO. 3 452 00 01120

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

SIGN.DATE

INVENTORY NO.



NOTE: 1. COMPLETE PIPING TILL BURNT OIL PIT SHALL BE SUPPLIED BY BHEL, BHOPAL.
2. THE ONLINE DGA SHALL BE MOUNTED ON THE VALVE (ITEM NO.-14a) AND ALSO SUPPORTED BY THE SUPPORT STRUCTURE PROVIDED ON THE TANK WALL.
3. ORIENTATION OF COOLER CONTROL CABINET (CCC) TO SUIT THE SITE.

REV	DATE	ALT.			ZONE
		CKD.			
		APPD.			

REV	DATE	ALT.			ZONE
		CKD.			
		APPD.			

REV	DATE	ALT.			ZONE
02	12.10.19	CKD.	SKC	-SD-	COMMENTS INCORPORATED AS PER LETTER NO. 11403A-EL-VDT-231 DTD. 06.09.2019
		APPD.	LK/AJ	-SD-	

REV	DATE	ALT.			ZONE
01	31.07.19	CKD.	SKC	-SD-	THE SIZING (RATING) OF THE GENERATOR TRANSFORMER IS AS PER THE ELECTRICAL SINGLE LINE DIAGRAM SUBMITTED BY BHEL PEM.
		APPD.	LK/AJ	-SD-	

TYPE OF PRODUCT	7 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER
PROJECT	2 X 660 MW UDANGUDI TPP-STAGE I
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BENGALURU

BHEL DRAWING/DOCUMENT NO	BP-DG-435-301-0001
ADDITIONAL INFORMATION	W.O.- 67022-A-512-01
	STATUS OF DRAWING "PR"
	DISTRIBUTION OF PRINTS
	TRE-1, TRM-3
PO. NO.	

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	- - - - -	COMP.SCALE-1:1

TITLE/- OUTLINE GENERAL ARRANGEMENT (PLAN VIEW)

	NAME	SIGN	DATE
DRN.	SKC		29.11.2018
CHD.	GK/AK		03.12.2018
APPD.	LK/RKS		04.12.2018

DRG. NO. 3 452 00 01120 REV. 02

SHEET 02 OF 04

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

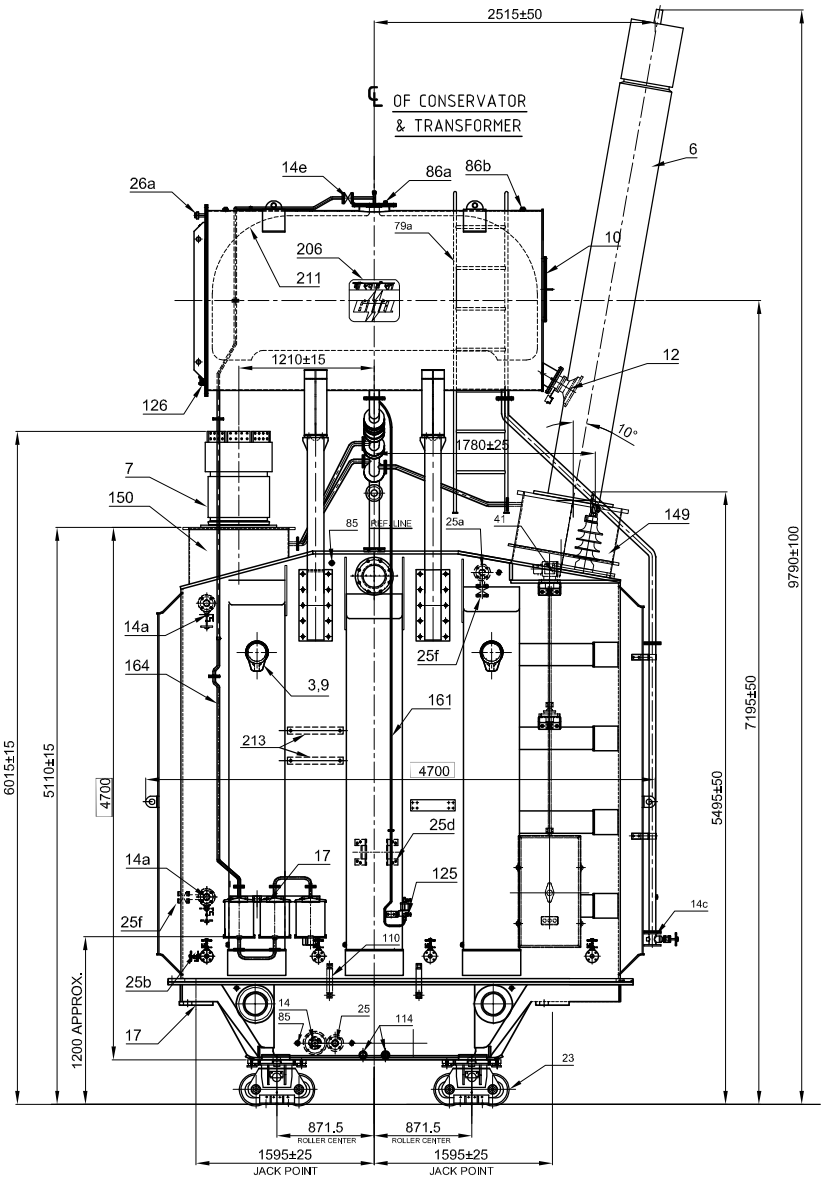
DRG. NO. 3 452 00 01120

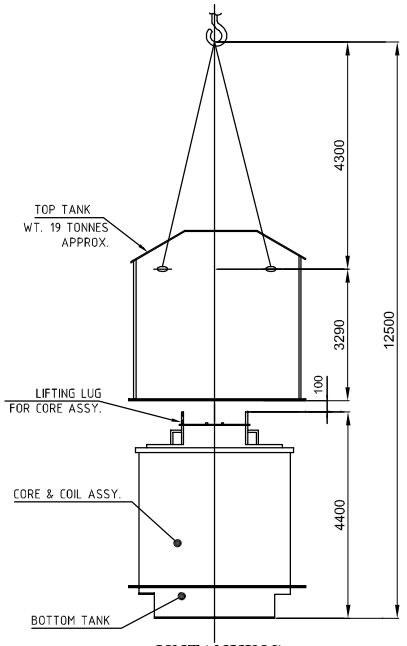
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

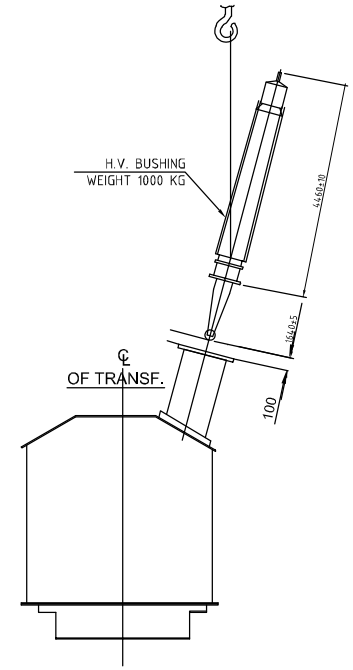
SIGN.DATE

INVENTORY NO.





UNTANKING



DISCONNECTION–HV BUSHING

REV	DATE	ALT.				REV	DATE	ALT.				REV	DATE	ALT.	SKC	-SD-	REV	DATE	ALT.	SKC	-SD-
		CKD.						CKD.				02	12.10.19	CKD.	GK/AK	-SD-	01	31.07.19	CKD.	GK/AK	-SD-
		APPD.						APPD.						APPD.	LK/AJ	-SD-			APPD.	LK/AJ	-SD-
ZONE						ZONE						ZONE	COMMENTS INCORPORATED AS PER LETTER NO. 11403A-EL-VDT-231 DTD. 06.09.2019				ZONE	THE SIZING (RATING) OF THE GENERATOR TRANSFORMER IS AS PER THE ELECTRICAL SINGLE LINE DIAGRAM SUBMITTED BY BHEL PEM.			

BHEL DRAWING/DOCUMENT NO	BP-DG-435-301-0001
ADDITIONAL INFORMATION	W.O.- 67022-A-512-01
	STATUS OF DRAWING "PR"
	DISTRIBUTION OF PRINTS
	TRE-1, TRM-3
PO. NO.	

TYPE OF PRODUCT	7 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER
PROJECT	2 X 660 MW UDANGUDI TPP-STAGE I
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BENGALURU

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	- - - - -	COMP.SCALE-1:1

TITLE/- OUTLINE GENERAL ARRANGEMENT (END VIEW)

	NAME	SIGN	DATE
DRN.	SKC		29.11.2018
CHD.	GK/AK		03.12.2018
APPD.	LK/RKS		04.12.2018

DRG. NO. 3 452 00 01120 REV. 02

SHEET 03 OF 04

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF.WO.NO. 63003-P-517-01
REF.DRG.NO. 3 469 00 01468

SIGN.DATE

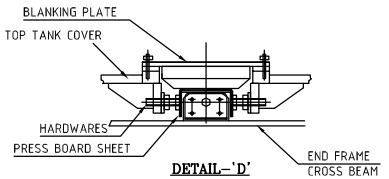
INVENTORY NO.

NOTE:-

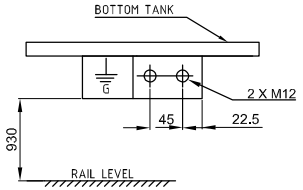
1. WHEN REFERRING THIS DRAWING PLEASE QUOTE MVA & W.O. NO.
2. 320 DIA. TWIN BI-DIRECTIONAL ROLLERS MOUNTED AT 1676 mm RAIL GAUGE IN BOTH DIRECTION ARE PROVIDED FOR MOVEMENT OF REACTOR AT SITE AND ROLLERS ARE TO BE REMOVED BEFORE ERECTION.
3. PAINTING AT OUTSIDE THE REACTOR TANK & COOLER CONTROL CABINET IS AS PER SHADE NO. 631 OF IS:5.
4. WIRING FROM INSTRUMENT CTS. ETC. ARE NOT SHOWN FOR CLARITY.
5. FOUNDATION BOLTS ARE IN THE SCOPE OF BHEL SUPPLY.
6. FOR FOR NOTES, REFERENCE DRAWINGS, DETAILS OF WEIGHT OIL QUANTITIES AND PART LIST, REFER DRG. NO. 34520001121.
7. DIMENSION SHOWN THUS ▭ ARE OVERALL SHIPPING DIMENSIONS EXCLUSIVE OF PACKING.
8. DIMENSIONS SHOWN ARE WITH REF.TO PLINTH LEVEL. PLEASE NOTE THAT PLINTH LEVEL IS 450 MM ABOVE THE GROUND LEVEL.

IMPORTANT NOTE :-

1. THE DESIGN FEATURES SHOWN ON THIS DRAWING (GENERALLY INLINE WITH IEC : 60076-6 APPLICABLE STANDARD & AGREED CUSTOMER SPECIFICATION) MEETS THE STATUTORY, REGULATORY & SAFETY REQUIREMENTS WITH RESPECT TO EARTHING ARRANGEMENT, DANGER & OTHER LABELS, CLEARANCES IN AIR PROVISION FOR PRESSURE RELIEF DEVICE, GAS ACTUATED RELAY AND ANTI-EARTHQUAKE CLAMPING ARRANGEMENT.

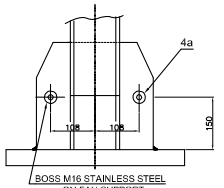


DETAIL–'D'
CLAMPING OF CORE WITH TANK COVER

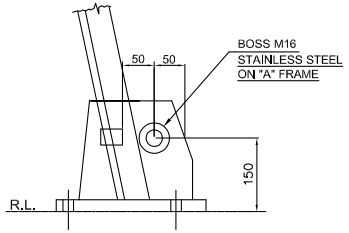


DETAIL–A
EARTHING TERMINAL PLATE

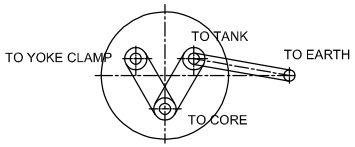
MIN. AIR CLEARANCES (IN MM)			
	420 KV HV	36 KV LV	36 KV HVN
PHASE TO PHASE	4000	NA	NA
PHASE TO EARTH	3500	320	320



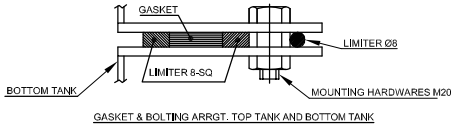
DETAIL – B



DETAIL – "C"



DETAIL- 'E'
EARTHING TERMINAL BOX



GASKET & BOLTING ARRGT. TOP TANK AND BOTTOM TANK

NOTE:-
1. FOR NOTES, REFERENCE DRAWINGS, DETAILS OF WEIGHT & OIL QUANTITES AND PART LIST, REFER DRG. NO. 34520001121.

REV	DATE	ALT.				CKD.				APPD.			
ZONE													

REV	DATE	ALT.				CKD.				APPD.			
ZONE													

REV	DATE	ALT.				CKD.				APPD.			
02	12.10.19	CKD.	GK/AK	-SD-		APPD.	LK/AJ	-SD-					
ZONE	COMMENTS INCORPORATED AS PER LETTER NO. 11403A-EL-VDT-231 DTD. 06.09.2019												

REV	DATE	ALT.				CKD.				APPD.			
01	31.07.19	CKD.	GK/AK	-SD-		APPD.	LK/AJ	-SD-					
ZONE	THE SIZING (RATING) OF THE GENERATOR TRANSFORMER IS AS PER THE ELECTRICAL SINGLE LINE DIAGRAM SUBMITTED BY BHEL PEM.												

BHEL DRAWING/DOCUMENT NO	BP-DG-435-301-0001
ADDITIONAL INFORMATION	W.O.- 67022-A-512-01
	STATUS OF DRAWING "PR"
	DISTRIBUTION OF PRINTS
	TRE-1, TRM-3
PO. NO.	

TYPE OF PRODUCT	7 X 275 MVA, 21/420/√3 KV, 1-PH, ONAN/ONAF/OFAF, GENERATOR TRANSFORMER
PROJECT	2 X 660 MW UDANGUDI TPP-STAGE I
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BENGALURU

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406	-----	COMP.SCALE-1:1

	NAME	SIGN	DATE
DRN.	SKC		29.11.2018
CHD.	GK/AK		03.12.2018
APPD.	LK/RKS		04.12.2018

TITLE/- OUTLINE GENERAL ARRANGEMENT (END VIEW)

DRG. NO. 3 452 00 01120 REV. 02

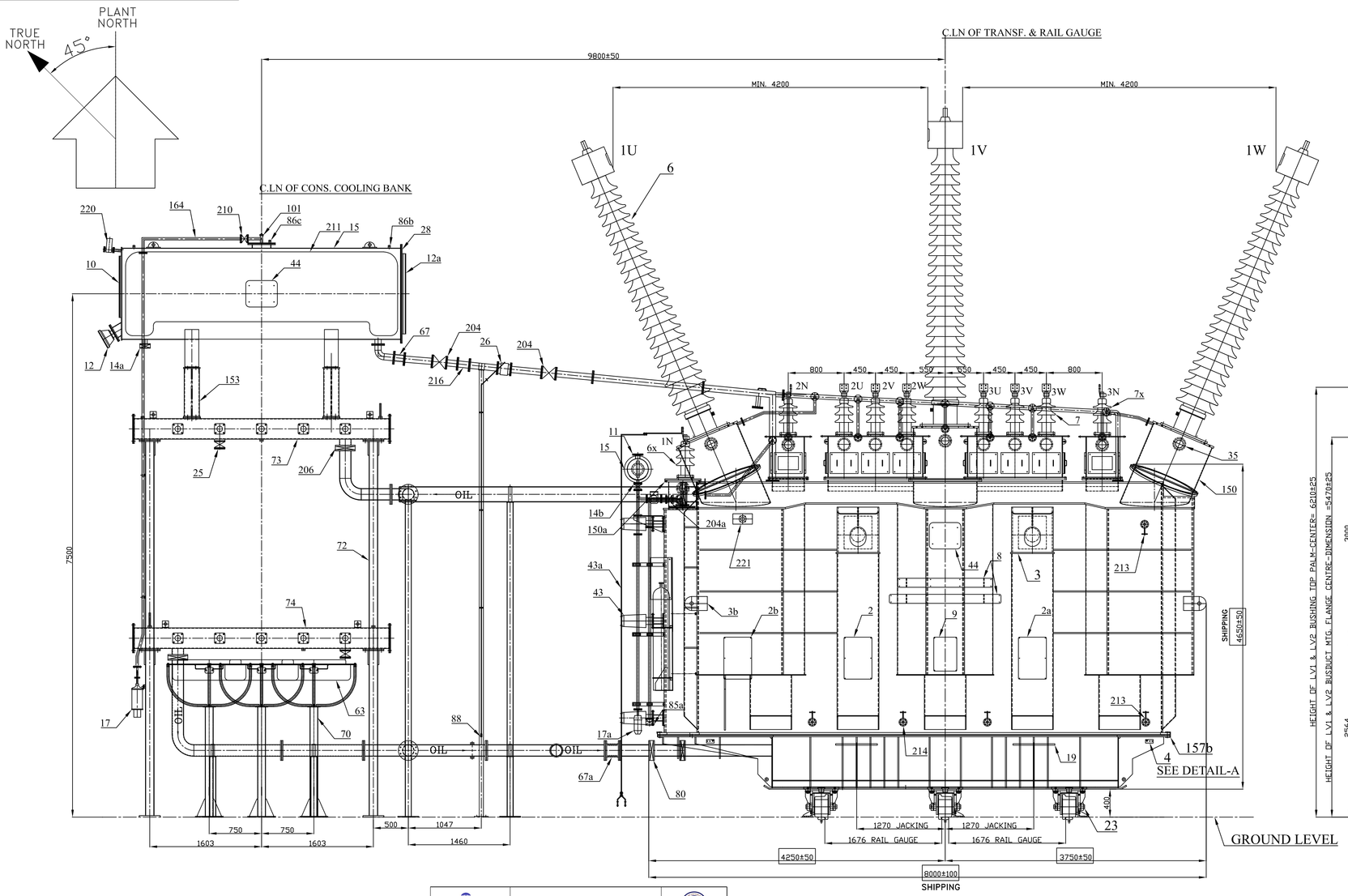
SHEET 04 OF 04

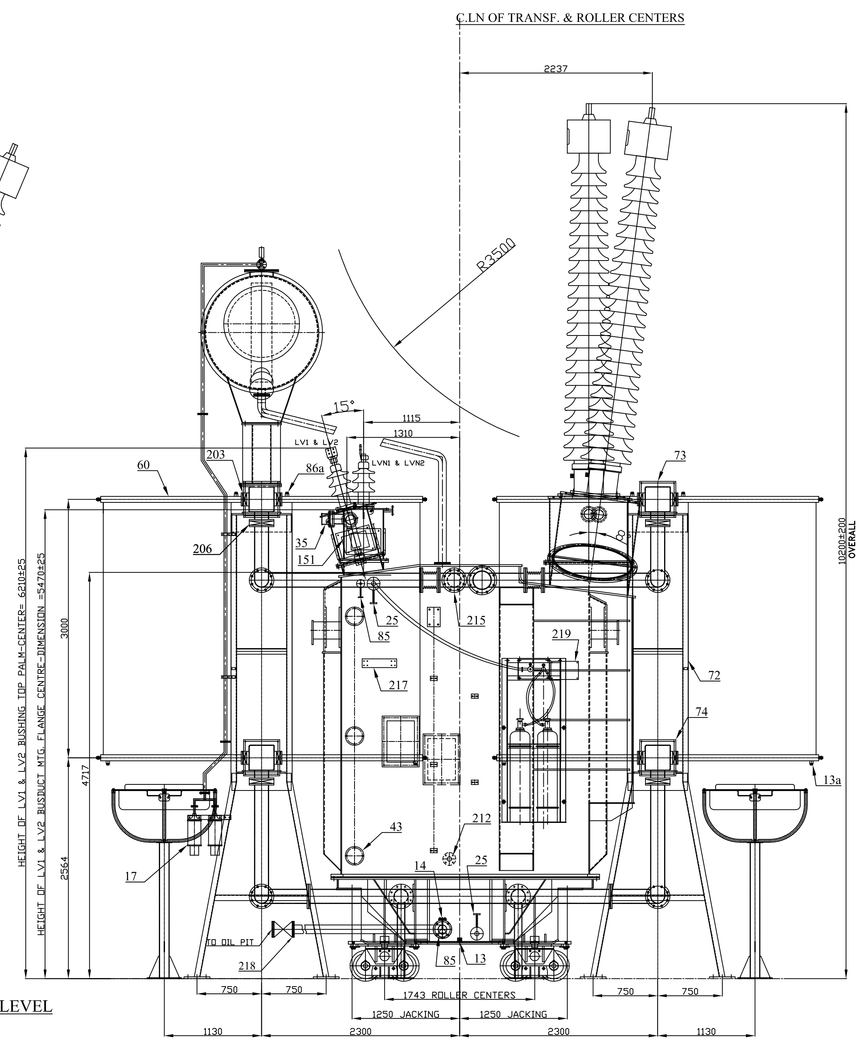
First Angle Projection

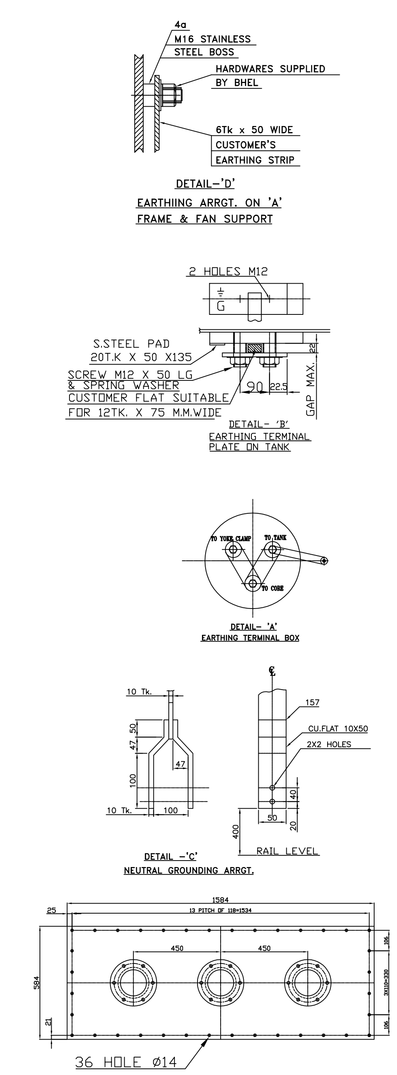
All dimensions in 'mm'

DRG.NO.146000500 14

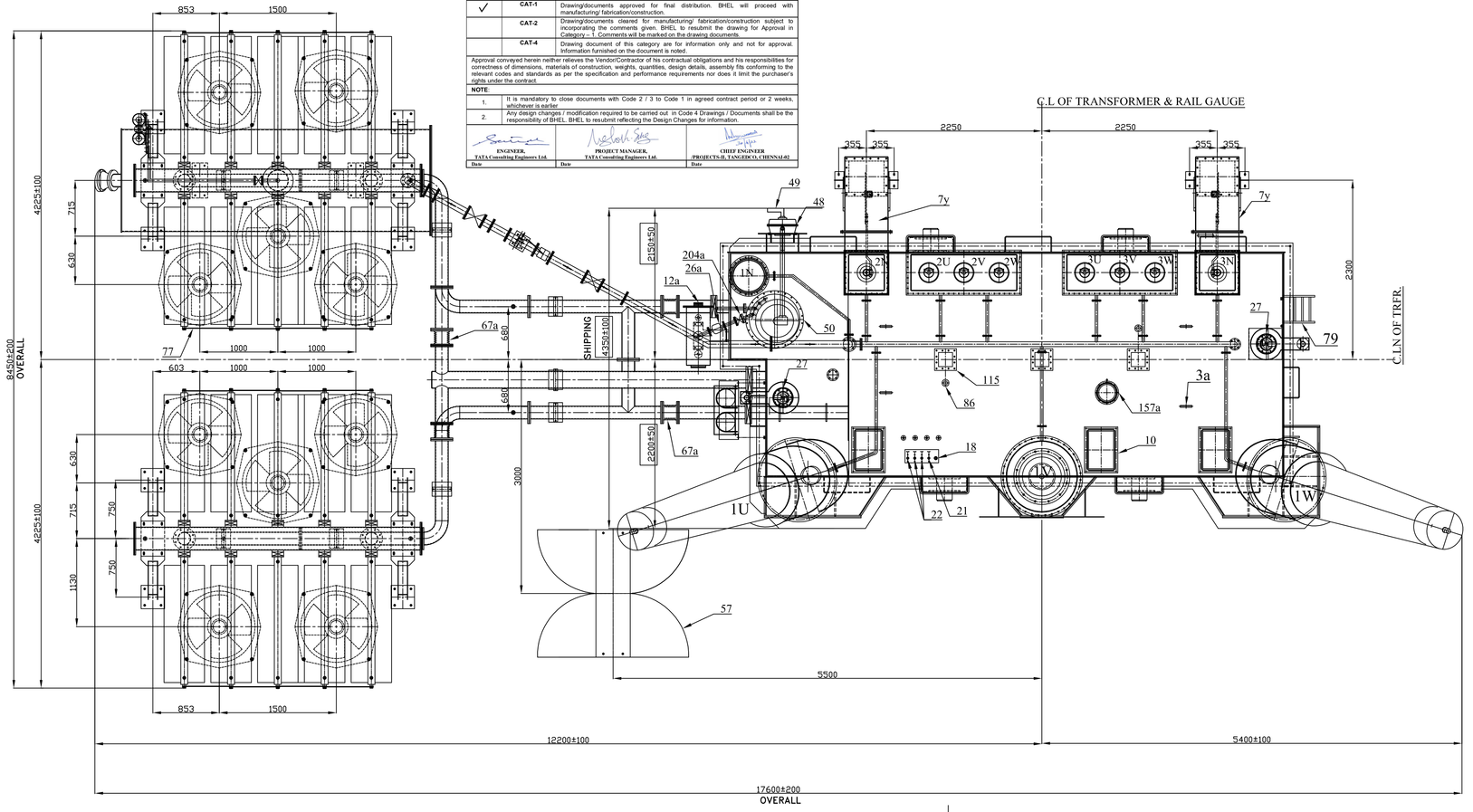
The information on this doc iment is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company

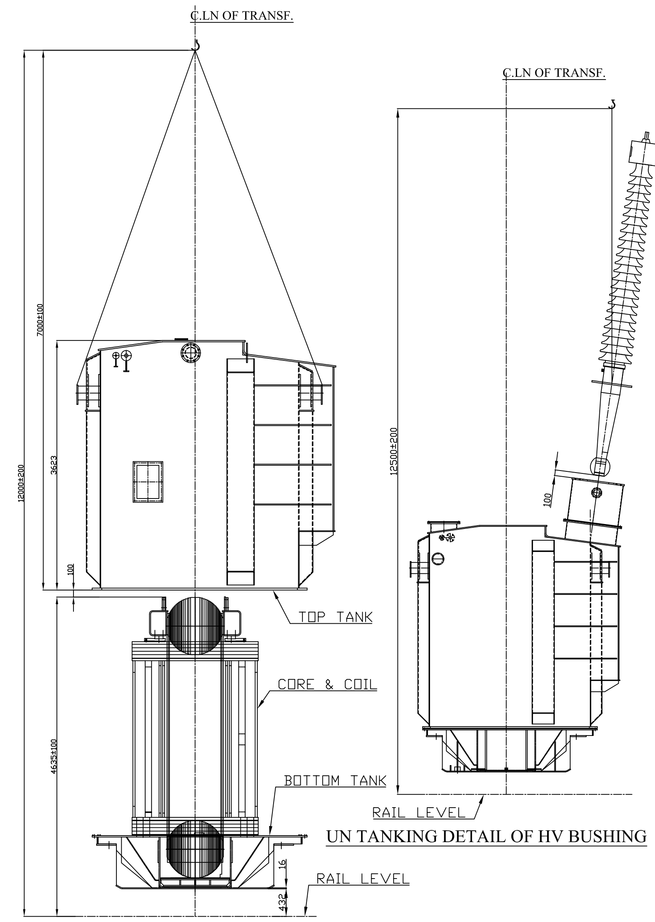






LV BUSDUCT MOUNTING FLANGE





UN TANKING DETAIL OF HV BUSHING

UN TANKING DETAIL OF TRANSFORMER

DIRECTION OF WITHDRAWAL

TABLE OF REFERENCE DRAWINGS		
SR. NO.	DESCRIPTION	DRG.NO.
01	OUT LINE GENERAL ARRANGEMENT	1 460 00 50 014
02	RATING & DIAGRAM PLATE (ENGLISH)	1 460 19 50 049
03	VALVE SHEDULE PLATE	1 460 19 50 050
04	FOUNDATION PLAN OF TRFR.	2 460 00 50 031
05	LOADING GAUGE	2 460 00 50 033
06	OIL FILLING INSTRUCTION PLATE	2 460 19 50 028
07	420 KV, 1250 AMPS. H.V. BUSHING	3 460 00 50 419
08	36 kV, 3150 AMPS. L.V. & L.V.N. BUSHING	3 460 00 50 420
09	36 kV, 3150 AMPS. H.V.N BUSHING	3 460 00 50 421
010	320 DIA TWIN ROLLER	3 460 00 50 422
011	LVN CABLE BOX ASSEMBLY	3 460 00 50 432

APPROXIMATE WEIGHT	
DESCRIPTION	WT.IN KG.
CORE & WINDINGS	96900
TANK+FITTINGS (INCLUDING RADITORS) + ACCESSORIES	65000
OIL IN KG.	64000
TOTAL WEIGHT	226800
SHIPPING WEIGHT (N2 GAS FILLED)	123500
UN TANKING WEIGHT	12000

AIR CLEARANCES (min)		
	PHASE TO PHASE	PHASE TO EARTH
H.V.	4200	3500
L.V1.	130	80
L.V2.	130	80
H.V.N.	--	320
L.V1.N. & L.V2.N.	--	80

NOTES:-
1. WHEN REFERRING THE O.G.A DRG. PLEASE QUOTE 110/55-55MVA & W.O. N.0.72124N19800.
2. DIMENSIONS SHOWN THUS ▭ ARE OVERALL SHIPPING DIMENSIONS.
3. WIRING FROM INSTRUMENTS, CTS, ETC. NOT SHOWN FOR CLARITY.
4. PAINTING SHALL BE AS PER BHEL STANDARD PAINTING SCHEME & PAINT COLOUR SHALL BE SHADE 631 OF IS-5 PU PAINT.
5. WEIGHTS AND OIL QUANTITY ARE APPROXIMATE
6. SEPARATE DRAWINGS SHALL BE SUBMITTED FOR 1) SCHEMATIC OF OLTC 2) GA OF OLTC DRIVING MECHANISM, 3) COOLER CONTROL CABINET, 4) LVN CABLE BOX
7. RAIL LEVEL, GROUND LEVEL & PLINTH LEVEL ARE SAME.

TABLE OF FITTINGS		
ITEM NO.	DESCRIPTION	QTY.
2	COMBINED RATING & DIAGRAM PLATE (HINDI & ENGLISH)	01NO
2a	VALVE SCHEDULE PLATE	01NO.
2b	DO'S AND DONT'S PLATE	01NO.
3	LIFTINGS BOLARD	04NOS
3a	LIFTINGS LUGS FOR COVER	04NOS.
3b	LASHING LUGS	04NOS.
4	EARTHING TERMINALS	02NOS.
6	H.V. LINE TERMINALS 420 KV, 1250 AMP.	03NOS.
6x	H.V.NEUTRAL TERMINAL 36 KV, 3150 AMP.	01NO.
7	L.V1 & L.V2 LINE TERMINAL 36 KV, 3150 AMPS.	06NOS.
7x	L.V1 & L.V2 NEUTRAL TERMINAL 36 KV, 3150 AMPS.	02NOS.
7y	L.V1 & L.V2 NEUTRAL CABLE BOX WITH PRV	02NOS.
8	NAME PLATE (HINDI & ENGLISH)	02NOS.
9	OIL FILLING INSTRUCTION PLATE	01NO.
10	INSPECTION COVERS	06NOS.
11	OIL FILLING HOLES ON O.L.T.C. CONSERVATOR	01NO.
12	MAGNETIC OIL GAUGE	01NO.
12a	PRISMETIC OIL GAUGE FOR MAIN & OLTC CONSERVATOR	01+01NO
13	DRAIN PLUG 1"BSP	02NOS.
13a	DRAIN PLUG 1/4"BSP FOR RADIATORS & HEADER	24NOS.
14	DRAIN VALVE ON TANK (100 NB)	01NO.
14a	DRAIN VALVE ON MAIN CONSERVATOR (50 NB)	01NO.
14b	DRAIN VALVE ON OLTC CONSERVATOR (25 NB)	01NO.
15	OIL CONSERVATOR (AIR CELL TYPE)	01NO.
15a	OLTC CONSERVATOR	01NO.
17	DEHYDRATING BREATHER FOR MAIN CONSERVATOR	02NOS.
17a	DEHYDRATING BREATHER FOR OLTC CONSERVATOR	01NO.
18	THERMOMETER POCKETS (WITH ALCOHAL THERMOMETER)	01NO.
19	JACKING PADS	04NOS.
21	OIL TEMPERATURE INDICATOR	01NOS.
22	WINDING TEMPERATURE INDICATOR	03NOS.
23	FLANGE BI-DIRECTIONAL ø 320 TWIN ROLLER WITH STOPPER ARRGT.	06NOS.
25	FILTER VALVE ON TANK & PIPE WORK (50 NB. B/F)	07NOS.
26	BUCHHOLZ RELAY (80NB)	01NO.
26a	OIL SURGE RELAY (25NB)	01NO.
27	PRESSURE RELIEF VALVE WITH DISCHARGE PIPE	02NOS.
28	END COVER FOR MAIN CONSERVATOR	01NO.
35	CT TERMINAL BOARD (HV,HVN,LV & LVN)	08NOS.
43	33 KV, POST INSULATOR FOR HV NEUTRAL GROUNDING STRIPS	02 NO.
43a	HV NEUTRAL GROUNDING STRIPS	02 NO.
44	BILINGUAL COMPANY'S MONOGRAM ON TANK & MAIN CONSERVATOR)	02NOS.
48	MOTOR DRIVING GEAR (BHEL/CTR)	01NO.
49	HAND OPERATING HANDLE	01NO.
50	ON LOAD TAP CHANGER	01NO.
57	MARSHALLING KIOSK (GROUNDING MOUNTED)	01NO.
60	RADIATORS	20NOS.
63	FAN & MOTOR (08 RUNNING + 02 STANDBY)	10NOS.
67	FLEXIBLE JOINT (80NB)	01NO.
67a	FLEXIBLE JOINT (150NB)	04NOS.
70	FAN SUPPORT	10NOS.
72	'A' FRAME (RADIATOR HEADERS SUPPORTS)	04NOS.
73	TOP HEADERS FOR COOLING BANK	02NOS.
74	BOTTOM HEADERS FOR COOLING BANK	02NOS.
77	RADIATOR TIE BAR	16NOS.
79	LADDER WITH SAFETY FLAP	01NO.
80	OIL INLET VALVE (150NB BUTTERFLY) ON TANK	02NOS.
81	OIL OUTLET VALVE (200 NB BUTTERFLY) ON CONSERVATOR	01NO.
85	SAMPLING VALVE (15 NB) ON TANK	02NOS.
85a	SAMPLING VALVE (25NB) FOR OLTC DIVERTER SWITCH	01NO.
86	AIR RELEASE VALVE (15 NB) ON COVER	02NOS.
86a	AIR RELEASE PLUG ON RADIATORS, HEADERS,	24NOS.
86b	AIR RELEASE PLUGES (3/4" BSP) ON MAIN CONSERVATOR	02NOS.
86c	AIR RELEASE PLUG (1/4" BSP) ON MAIN CONSERVATOR	01NO.
88	BUCHHOLZ GAS RELEASE COCK (6 NB)	01NO.
101	PRESSURE GAUGE ON MAIN CONSERVATOR	01NO.
115	HOLE FOR CLAMPING CORE AND COIL TO TANK COVER	02NOS.
150	HV TURRET (DETACHABLE)	03NOS.
150a	HV NEUTRAL TURRET	01NO.
151	LV TURRET (DETACHABLE)	02NOS.
153	CONSERVATOR SUPPORT FOR MAIN CONSERVATOR	02NOS.
157a	EARTHING CONNECTION BETWEEN CORE TO END FRAME & END FRAME TO TANK	01NO.
157b	EARTHING CONNECTION BETWEEN TOP TANK TO BOTTOM TANK	02NOS.
164	BREATHER PIPE (25NB)	02NOS.
203	RADIATOR VALVE (80 NB BUTTERFLY)	40NOS.
204	CONSERVATOR VALVE (80 NB)	02NOS.
204a	OLTC CONSERVATOR VALVE (25 NB)	01NO.
206	VALVE FOR DISCONNECTING RADIATOR BANK (150 NB B/F)	04NOS.
210	VALVE (25 NB) FOR BREATHER CONNECTION ON MAIN CONSERVATOR	01NO.
211	FLEXIBLE SEPERATOR (AIR CELL)	01NO.
212	PARTIAL DISCHARGE VALVE	02NOS.
213	VALVE (25 NB) ON LINE D.G.A.	02NOS.
214	25 NB GATE VALVE FOR NITROGEN INJECTION3 ON HV SIDE + 3 ON LV SIDE)	06NOS.
215	150NB GATE VALVE FOR QUICK DRAIN FOR NIFPS	01NO.
216	CONSERVTAOR ISOLATION VALVE FOR NIFPS (TCIV VALVE)	01NO.
217	IMPACT RECORDER	01NO.
218	DRAIN VALVE IN DRAIN PIPE	01NO.
219	NIFPES SIGNAL BOX	01NO.
220	AIRCELL RUPTURE INDICATOR	01NO.
221	SUDDEN PRESSURE RELAY	01NO.

DIMINISION TABLE							
	TANK				OVERALL DIMNS.		
	LHS SIDE	RHS SIDE	TOTAL		LHS SIDE	RHS SIDE	TOTAL
LENGTH	4300	3800	8100		12200	5400	17600
WIDTH	2200	2150	4350		4250	4250	8500
HEIGHT			4650				10160

TATA — TATA CONSULTING ENGINEERS LIMITED

UDANGUDI SUPER CRITICAL THERMAL POWER PROJECT (2 X 660 MW)

✓	CAT-1	Drawing/documents approved for final distribution. BHEL will proceed with manufacturing/ fabrication/construction.
	CAT-2	Drawing/documents approved for manufacturing/ fabrication/construction subject to incorporating the comments given. BHEL to resubmit the drawing for Approval in Category – 1. Comments will be marked on the drawing documents.
	CAT-4	Drawing document of this category are for information only and not for approval. Information furnished on the document is noted.

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 conforming to the requirements of the standards as per the specification and performance requirements nor does it limit the purchaser's rights under the contract.

NOTE

1.	It is mandatory to close documents with Code 2 / 3 for Code 1 in agreed contract period or 2 weeks, whichever is earlier.
2.	Any design changes / modification required to be carried out in Code 4 Drawings / Documents shall be the responsibility of BHEL. BHEL to resubmit reflecting the Design Changes for information.

ENGINEER, TATA Consulting Engineers Ltd.	PROJECT MANAGER, TATA Consulting Engineers Ltd.	CHIEF ENGINEER (PROJECTS), B. TANGEDCO, CHENNAI-600
Date	Date	Date

REV	DATE	ALTERED / CHECKED / APPROVED	ZONE
01	13/4/22	ALTERED L.NU CHECKED V.SAI APPROVED A.SHI	LV BUSHING MTG POSITION CHANGED. IN MAIN CONSERVATOR AIR CELL RUPTURE INDICATOR DEVICE ADDED. CUSTOMER COMMENTS INCORPORATED.

ADDITIONAL INFORMATION
W.O. 72124N19800
STATUS OF DRAWING
U
DISTRIBUTION OF PRINTS

TRE	PPC	BAY 162	BAY 3,4&5	BAY 6&7	BAY 8	BAY 9	LMM	Other
								0

TYPE OF PRODUCT OR 110/55-55 MVA, 400/11.5-11.5 KV, ONAN/ONAF COOLED STANDBY TRANSFORMER

NAME OF CUSTOMER/PROJECT M/S:- UDANGUDI STPP STAGE-I 2X660 MW

BHARAT HEAVY ELECTRICALS LTD. JHANSI

	NAME	SIGN	DATE
DRN	PSR1		15/11/2019
CHD	ASH1		28/09/2021
APPD	CVS		28/09/2021

NO. OF VAR

DEPT-TRE CODE-406	UN. TOL DIM. C/M/F	SCALE	WEIGHT (KG)	REF. TO ASSY. NO.	ITEM NO	NO. OF ITEM

TITLE: OUTLINE GENERAL ARRANGEMENT

DRAWING NO. 14600050014 REV. 01

SHT NO 1 NO OF SHT 1

SIGNATURE NOT REQUIRED AS IT IS SYSTEM GENERATED DRAWING **SIZE A1**

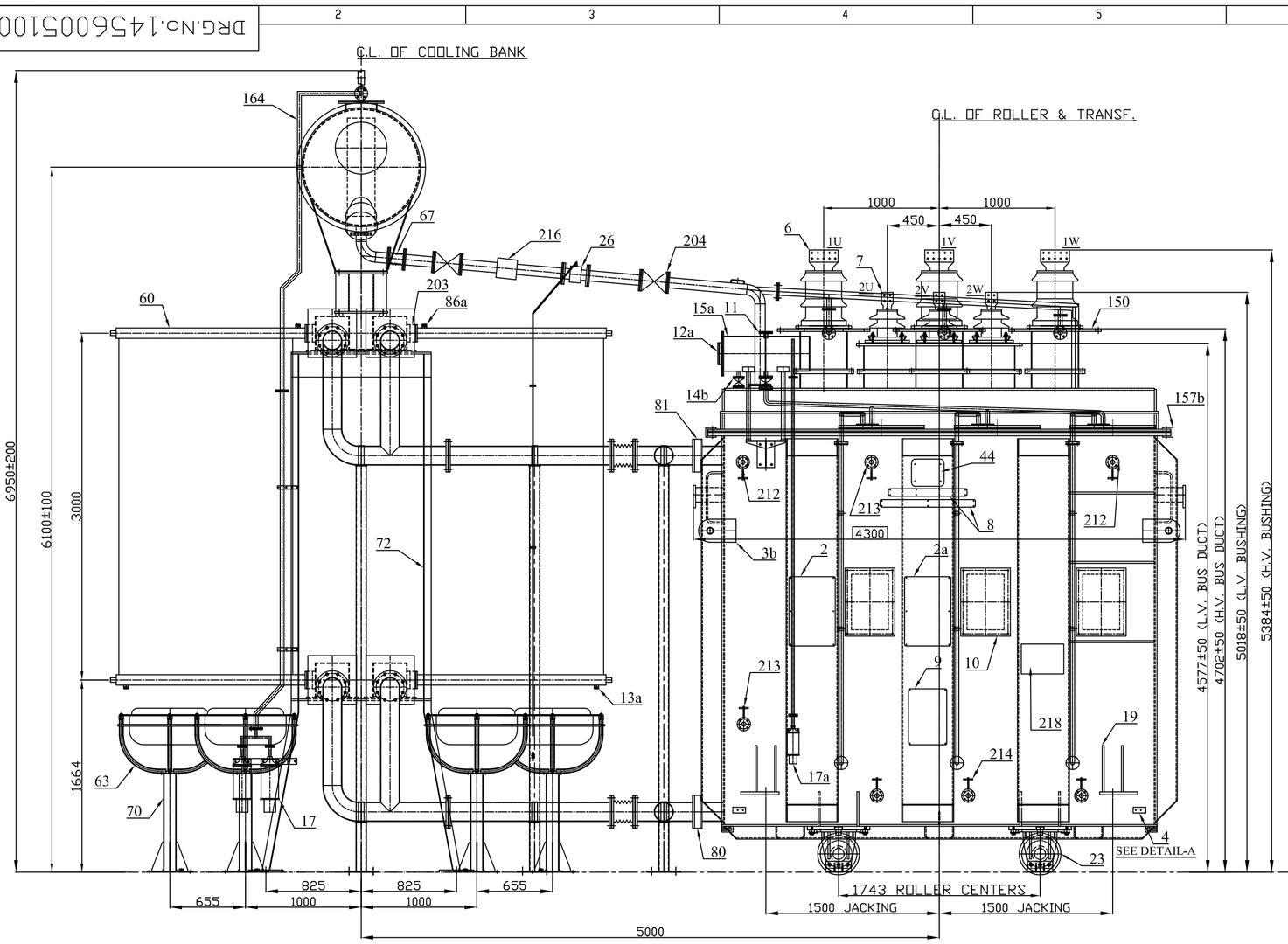
INVENTORY NO. | SIGN AND DATE | REF. DRG. NO.

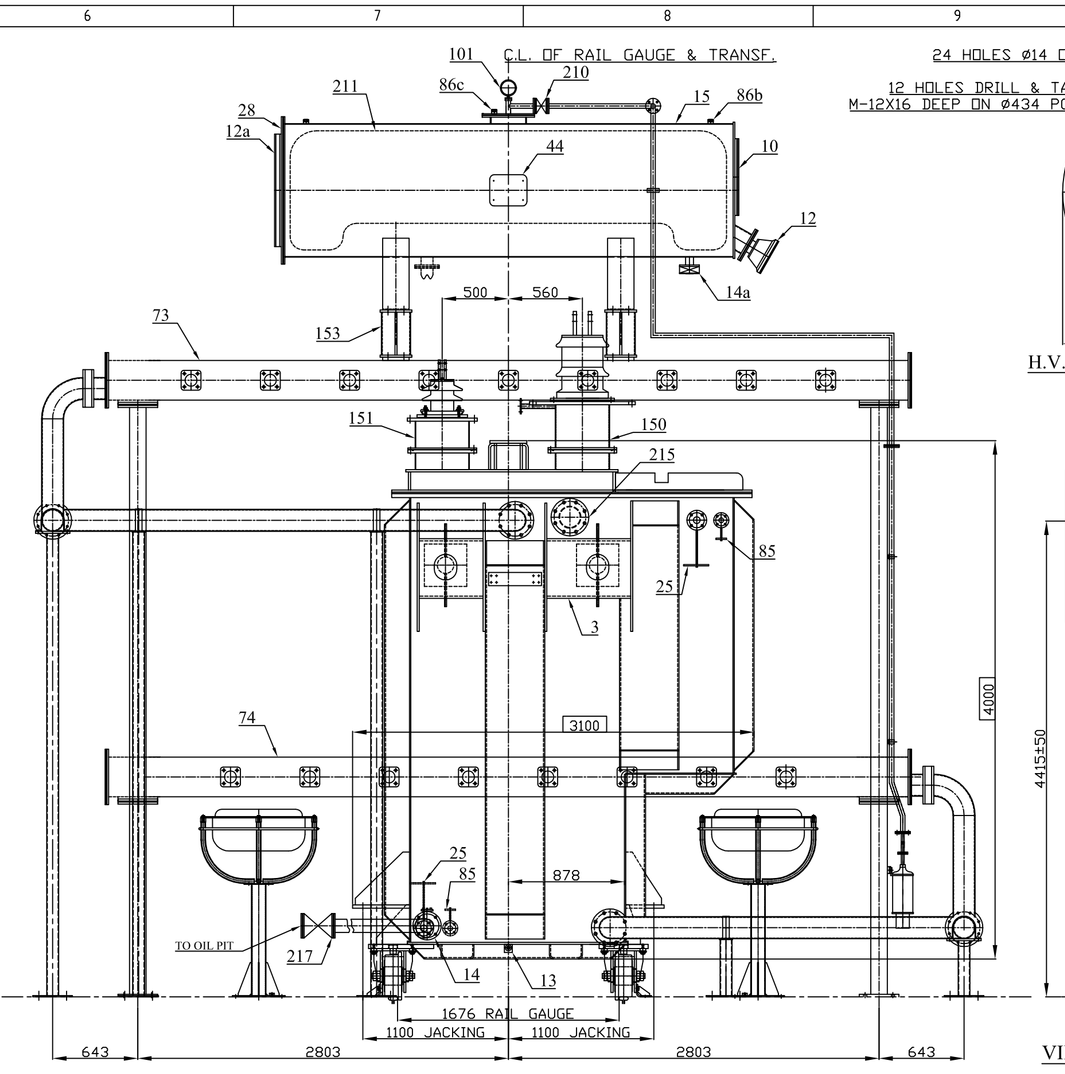
First Angle Projection

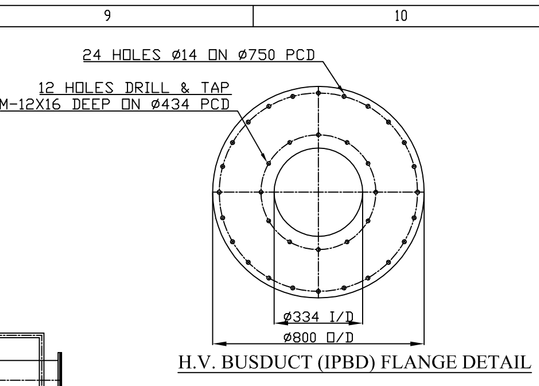
All dimensions in 'mm'

DRG.No.14560051007

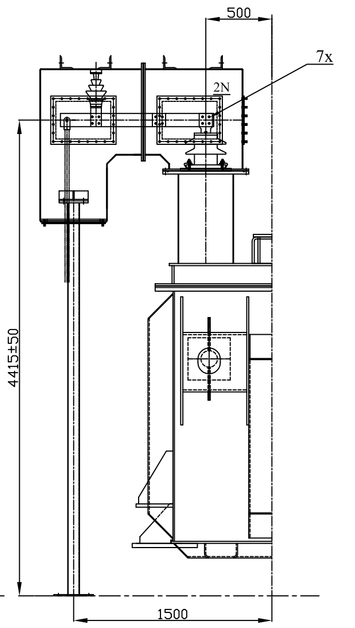
The information on this doc is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company



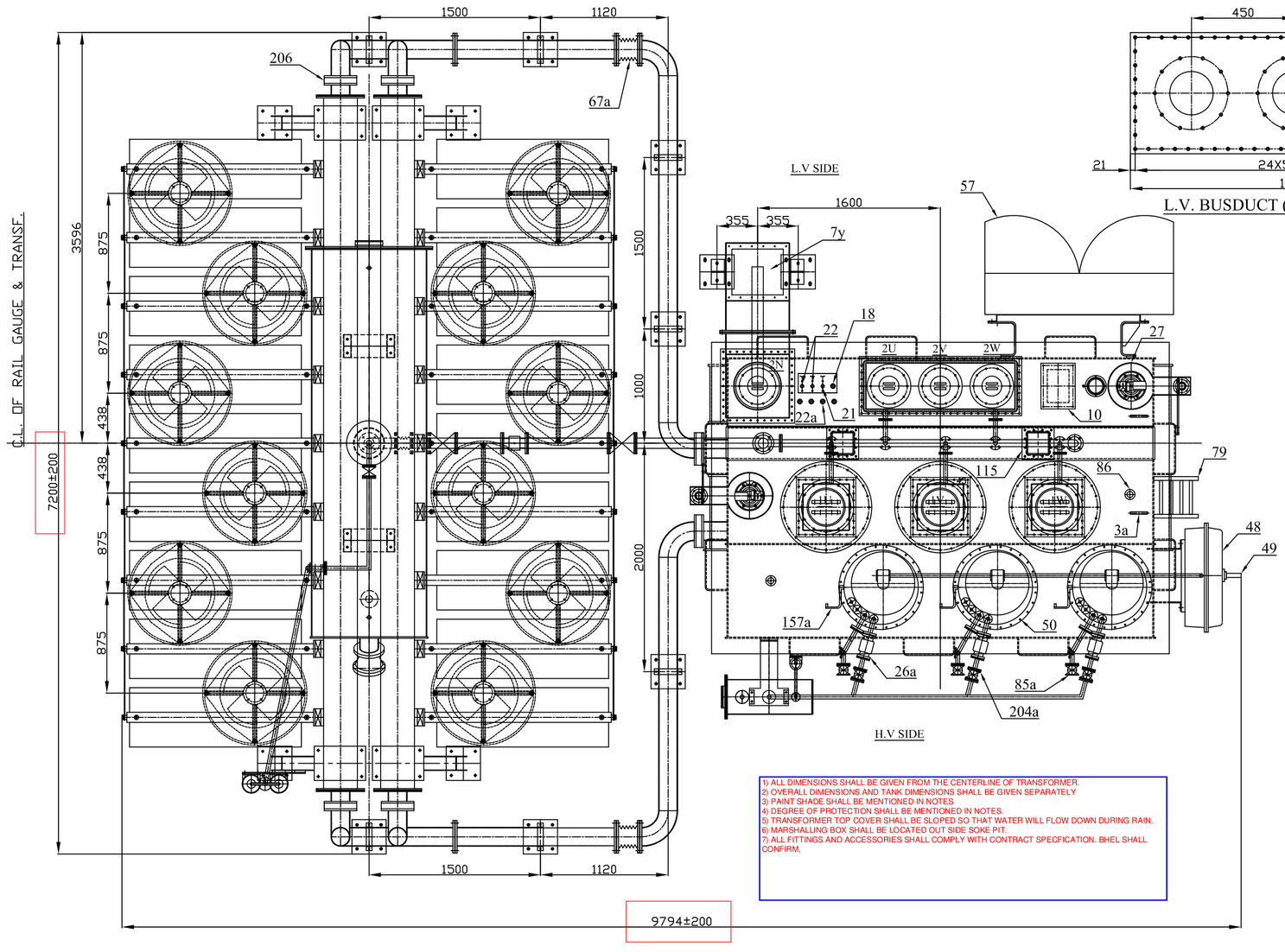


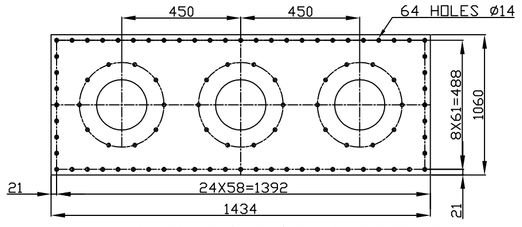


H.V. BUSDUCT (IPBD) FLANGE DETAIL

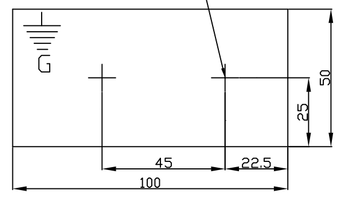


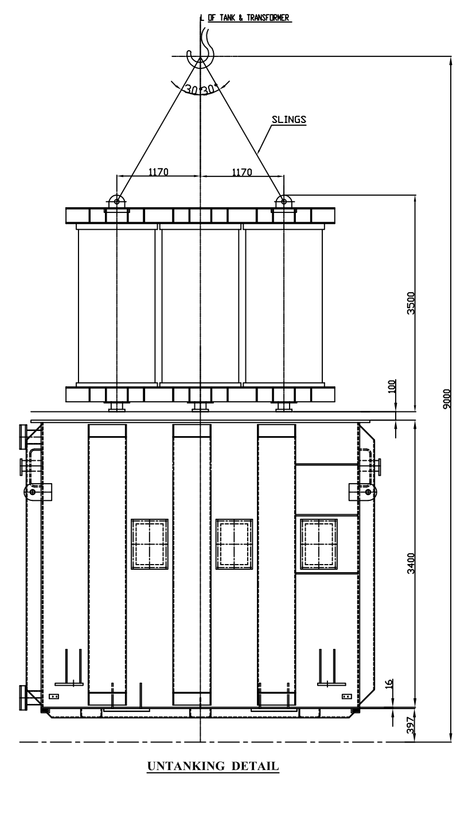
VIEW IN LVN CABLE BOX





L.V. BUSDUCT (SPBD) FLANGE DETAIL





UNTANKING DETAIL

DETAIL-A

TATA CONSULTING ENGINEERS LIMITED
VENDOR DRAWING STATUS

CATEGORY	DESCRIPTION
CAT-1	Drawing/documents approved for final distribution: BHEL will proceed with manufacturing/ fabrication/construction.
CAT-2	Drawing/documents are cleared for manufacturing/ fabrication/construction subject to incorporating the comments given. BHEL to resubmit the drawing/ documents incorporating the comments till its approval for the category - CAT-1 comments.
CAT-3	Drawing document will be commented as per comment and resubmitted by BHEL for further review/checking.
CAT-4	Drawing/document of this category are for information only and not for approval. Information involved on this document is noted.

Note :-
1. It is mandatory to close documents with Code 2 & 3 to Code 1 in agreed contractual period or 2 weeks, whichever is lower.
2. Any engineering / documentation change not indicated in the approved drawing / documents shall be the responsibility of BHEL. BHEL to resubmit reflecting the Design Changes for information.

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 supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchaser's rights under the contract.

Reviewed by ..... Date .....

TABLE OF FITTINGS

ITEM NO.	DESCRIPTION	QTY.
2	COMBINED RATING & DIAGRAM PLATE (HINDI & ENGLISH)	01NO
2a	VALVE SCHEDULE PLATE	01NO.
3	LIFTINGS BOLARD	04NOS
3a	LIFTINGS LUGS FOR COVER	04NOS
3b	LASHING LUGS	04NOS.
4	EARTHING TERMINALS	02NOS.
6	H.V. LINE TERMINALS 36 KV, 12500 AMPS.	03NOS.
7	L.V. LINE TERMINAL 17.5 KV, 5000 AMPS.	03NOS.
7x	L.V. NEUTRAL TERMINAL 17.5 KV, 5000 AMPS.	01NO.
7y	L.V. NEUTRAL CABLE BOX	01NO.
8	NAME PLATE (HINDI & ENGLISH)	02NOS.
9	OIL FILLING INSTRUCTION PLATE	01NO.
10	INSPECTION COVERS	08NOS.
11	OIL FILLING HOLES ON O.L.T.C. CONSERVATOR	01NO.
12	MAGNETIC OIL GAUGE	01NO.
12a	PRISMETIC OIL GAUGE FOR MAIN & OLTC CONSERVATOR	01+01NO.
13	DRAIN PLUG 1"BSP	02NOS.
13a	DRAIN PLUG 1/4"BSP FOR RADIATORS & HEADER	22NOS.
14	DRAIN VALVE DN TANK (100 NB)	01NO.
14a	DRAIN VALVE DN MAIN CONSERVATOR (50 NB)	01NO.
14b	DRAIN VALVE DN OLTC CONSERVATOR (25 NB)	01NO.
15	OIL CONSERVATOR (AIR CELL TYPE)	01NO.
15a	OLTC CONSERVATOR	01NO.
17	DEHYDRATING BREATHER FOR MAIN CONSERVATOR	02NOS.
17a	DEHYDRATING BREATHER FOR OLTC CONSERVATOR	01NO.
18	THERMOMETER POCKETS (WITH ALCOHAL THERMOMETER)	01NO.
19	JACKING PADS	04NOS.
21	OIL TEMPERATURE INDICATOR	01NOS.
22	WINDING TEMPERATURE INDICATOR	02NOS.
22a	RTD & WTI POCKET	04NOS.
23	FLANGE BI-DIRECTIONAL ø 320 SINGLE ROLLER WITH STOPPER ARRGT.	04NOS.
25	FILTER VALVE ON TANK & PIPE WORK (50 NB. B/F)	08NOS.
26	BUCHHOLZ RELAY (80NB)	01NO.
26a	OIL SURGE RELAY (25NB)	03NOS.
27	PRESSURE RELIEF VALVE	02NOS.
28	END COVER FOR MAIN CONSERVATOR	01NO.
35	CT TERMINAL BOARD (HV,HVN,LV & LVN)	07NOS.
44	BILINGUAL COMPANY'S MONOGRAM (ON TANK & MAIN CONSERVATOR)	02NOS.
48	MOTOR DRIVING GEAR	01NO.
49	HAND OPERATING HANDLE	01NO.
50	ON LOAD TAP CHANGER	03NOS.
57	MARSHALLING BOX	01NO.
60	RADIATORS	18NOS.
63	FAN & MOTOR (10 RUNNING + 02 STANDBY)	12NOS.
67	FLEXIBLE JOINT (80NB)	01NO.
67a	FLEXIBLE JOINT (150NB)	02NOS.
70	FAN SUPPORT	12NOS.
72	'A' FRAME (RADIATOR HEADERS SUPPORTS)	02NOS.
73	TOP HEADERS FOR COOLING BANK	02NOS.
74	BOTTOM HEADERS FOR COOLING BANK	02NOS.
77	RADIATOR TIE BAR	28NOS.
79	LADDER WITH SAFETY FLAP	01NO.
80	OIL INLET VALVE (150NB BUTTERFLY) ON TANK	01NO.
81	OIL OUTLET VALVE (150 NB BUTTERFLY) ON TANK	01NO.
85	SAMPLING VALVE (15 NB) ON TANK	02NOS.
85a	SAMPLING VALVE (25NB) FOR OLTC DIVERTER SWITCH	03NOS.
86	AIR RELEASE VALVE (15 NB) ON COVER	02NOS.
86a	AIR RELEASE PLUG ON RADIATORS, HEADERS,	20NOS.
86b	AIR RELEASE PLUGES (3/4" BSP) ON MAIN CONSERVATOR	02NOS.
68c	AIR RELEASE PLUG (1/4" BSP) ON MAIN CONSERVATOR	01NO.
88	BUCHHOLZ GAS RELEASE CODK (6 NB)	01NO.
101	PRESSURE GAUGE ON MAIN CONSERVATOR	01NO.
115	HOLE FOR CLAMPING CORE AND COIL TO TANK COVER	02NOS.
150	HV TURRET (DETACHABLE)	03NOS.
151	LV TURRET (DETACHABLE)	01NO.
153	CONSERVATOR SUPPORT FOR MAIN CONSERVATOR	02NOS.
157a	EARTHING CONNECTION BETWEEN CORE TO END FRAME & END FRAME TO TANK	01NO.
157b	EARTHING CONNECTION BETWEEN TOP TANK TO BOTTOM TANK	02NOS.
157c	EARTHING CONNECTION BETWEEN TAP CHANGER TO TANK COVER	03NOS.
164	BREATHER PIPE (25NB)	02NOS.
203	RADIATOR VALVE (80 NB BUTTERFLY)	36NOS.
204	CONSERVATOR VALVE (80 NB)	02NOS.
204a	OLTC CONSERVATOR VALVE (25 NB)	04NOS.
206	VALVE FOR DISCONNECTING RADIATOR BANK (150 NB B/F)	04NOS.
210	VALVE (25 NB) FOR BREATHER CONNECTION ON MAIN CONSERVATOR	01NO.
211	FLEXIBLE SEPERATOR (AIR CELL)	01NO.
212	PARTIAL DISCHARGE VALVE (25 NB)	04NOS.
213	VALVE (25 NB) ON LINE D.G.A.	02NOS.
214	25 NB GATE VALVE FOR NITROGEN INJECTION(3 ON HV SIDE + 3 ON LV SIDE)	06NOS.
215	150NB GATE VALVE FOR QUICK DRAIN FOR NIFPS	01NO.
216	CONSERVTAOR ISOLATION VALVE FOR NIFPES	01NO.
217	DRAIN VALVE (100 NB)	01NO.
218	SINGAL BOX FOR NIFPES	01NO.

TABLE OF REFERENCE DRAWINGS

SRL. NO.	DESCRIPTION	DRG.NO.
001	OUT LINE GENERAL ARRANGEMENT	1 456 00 51 007
002	RATING & DIAGRAM PLATE (ENGLISH)	1 456 19 51 705
003	VALVE SHEDULE PLATE	1 456 19 51 706
004	FOUNDATION PLAN OF TRFR.	2 456 00 51 196
005	LOADING GAUGE	2 456 00 51 299
006	OIL FILLING INSTRUCTION PLATE	2 456 19 50 946
007	36 KV, 12500 AMPS. H.V. BUSHING	3 456 00 52 541
008	17.5 kV, 5000 AMPS. L.V. BUSHING	3 456 00 52 542
009	17.5 kV, 5000 AMPS. L.V.N. BUSHING	3 456 00 52 543
010	320 DIA SINGLE ROLLER	3 456 00 52 544
011	L.V.N. CABLE BOX	3 456 00 52 771

APPROXIMATE WEIGHT

DESCRIPTION	WT.IN KG.
CORE & WINDINGS (INCLUDING OIL ABSORBED)	37000
TANK+FITTINGS (INCLUDING RADITORS) + ACCESSORIES	28000
OIL IN KG.	21000
TOTAL WEIGHT	86500
SHIPPING WEIGHT (N2 GAS FILLED)	50000

NOTES:-

1. WHEN REFERING THIS DRG. STATE 70 MVA & W.O.NO. 72125N17700
2. DIMENSIONS MARKED THUS ▭ ARE OVER ALL SHIPPING.
3. PVC, SWA, PVC ARMOURED CABLE WIRING BY BHEL, BUT NOT SHOWN IN THIS DRG. FOR CLARITY.
4. FOUNDATION BOLTS, NUTS & WASHERS ETC. ARE SUPPLIED BY BHEL.
5. OUT SIDE PAINTING SHALL BE PU PAINT TO SHADE 631 OF IS-5.
6. BEFORE FILLING OIL IN TRANSFORMER REFER INSTRUCTIONS GIVEN ON OIL FILLING INSTRUCTION PLATE (ITEM NO.9) FITTED WITH THIS TRANSFORMER.

1) ALL DIMENSIONS SHALL BE GIVEN FROM THE CENTERLINE OF TRANSFORMER.
2) OVERALL DIMENSIONS AND TANK DIMENSIONS SHALL BE GIVEN SEPARATELY
3) PAINT SHADE SHALL BE MENTIONED IN NOTES
4) DEGREE OF PROTECTION SHALL BE MENTIONED IN NOTES.
5) TRANSFORMER TOP COVER SHALL BE SLOPED SO THAT WATER WILL FLOW DOWN DURING RAIN.
6) MARSHALLING BOX SHALL BE LOCATED OUT SIDE SOKE PIT.
7) ALL FITTINGS AND ACCESSORIES SHALL COMPLY WITH CONTRACT SPECFICATION. BHEL SHALL CONFIRM.

AIR CLEARANCES IN BUS DUCT (min)

	PHASE TO PHASE	PHASE TO EARTH
H.V.	350	222
L.V.	130	80
L.V.N.	--	80

ADDITIONAL INFORMATION
W.O. 72125N17700
STATUS OF DRAWING
U
DISTRIBUTION OF PRINTS

TRE	PPC	BAY 1&2	BAY 3,4&5	BAY 6&7	BAY 8	BAY 9	LMM	Other
1	1					2		0

TYPE OF PRODUCT OR 70 MVA, 21/11.5 KV, ONAN/ONAF COOLED UNIT TRANSF.
NAME OF CUSTOMER/PROJECT M/S:- UDANGUDI STPP STAGE-I 2X660 MW

BHARAT HEAVY ELECTRICALS LTD. JHANSI

	NAME	SIGN	DATE
DRN	PSR1		02/11/2019
CHD	ASH1		
APPD			

NO. OF VAR

REV	DATE	ALTERED PSR1 CHECKED ASH1 APPROVED
00		

DEPT-TRE
CODE-406
UN. TOL. DIM. C/M/F
SCALE
WEIGHT (KG)
REF. TO ASSY. NO.
ITEM NO
NO. OF ITEM

TITLE
OUTLINE GENERAL ARRGT.

DRAWING NO. 14560051007
REV. 00
SHT NO 1
NO OF SHT 1

REV	DATE	ALTERED / CHECKED / APPROVED	ZONE

REF. DRG. NO.
SIGN AND DATE
INVENTORY NO.

SIGNATURE NOT REQUIRED AS IT IS SYSTEM GENERATED DRAWING

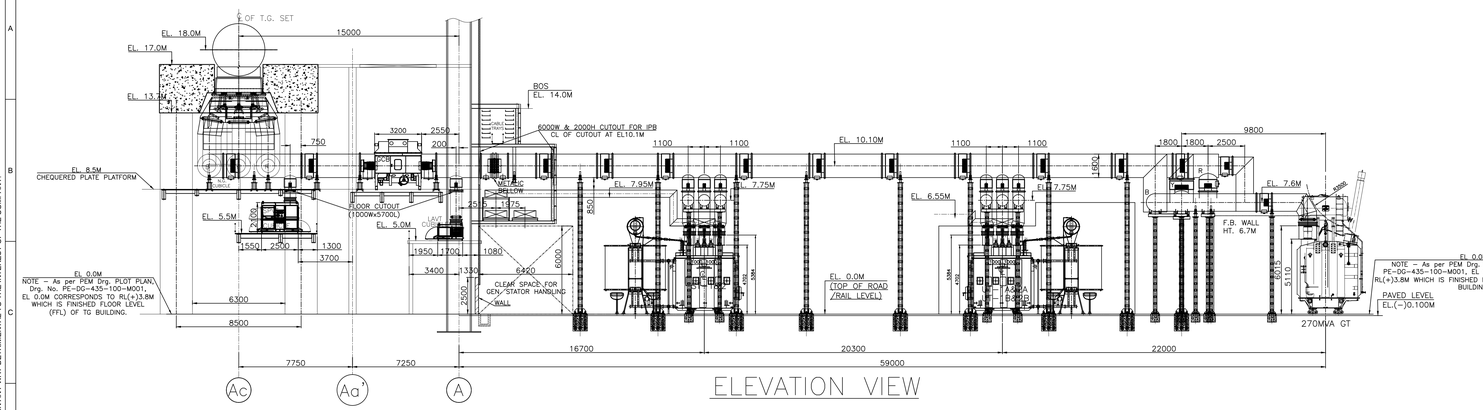
SIZE A1

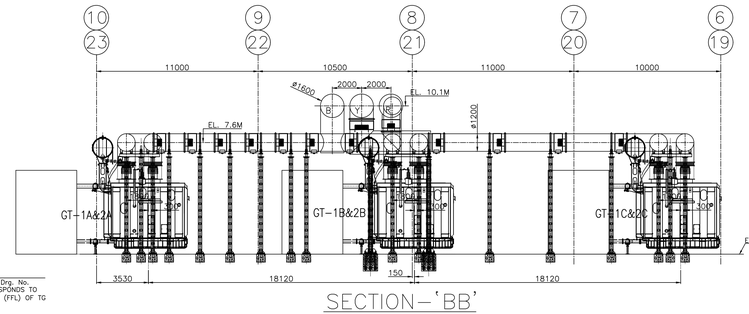
First Angle Projection

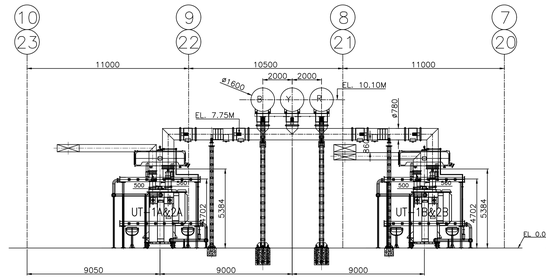
All Dimensions in 'mm'

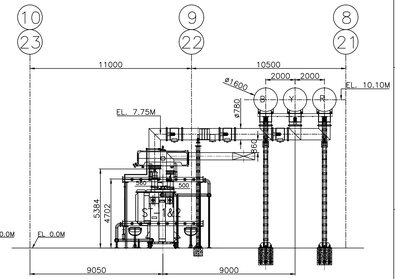
DRAWING NO 01791710001

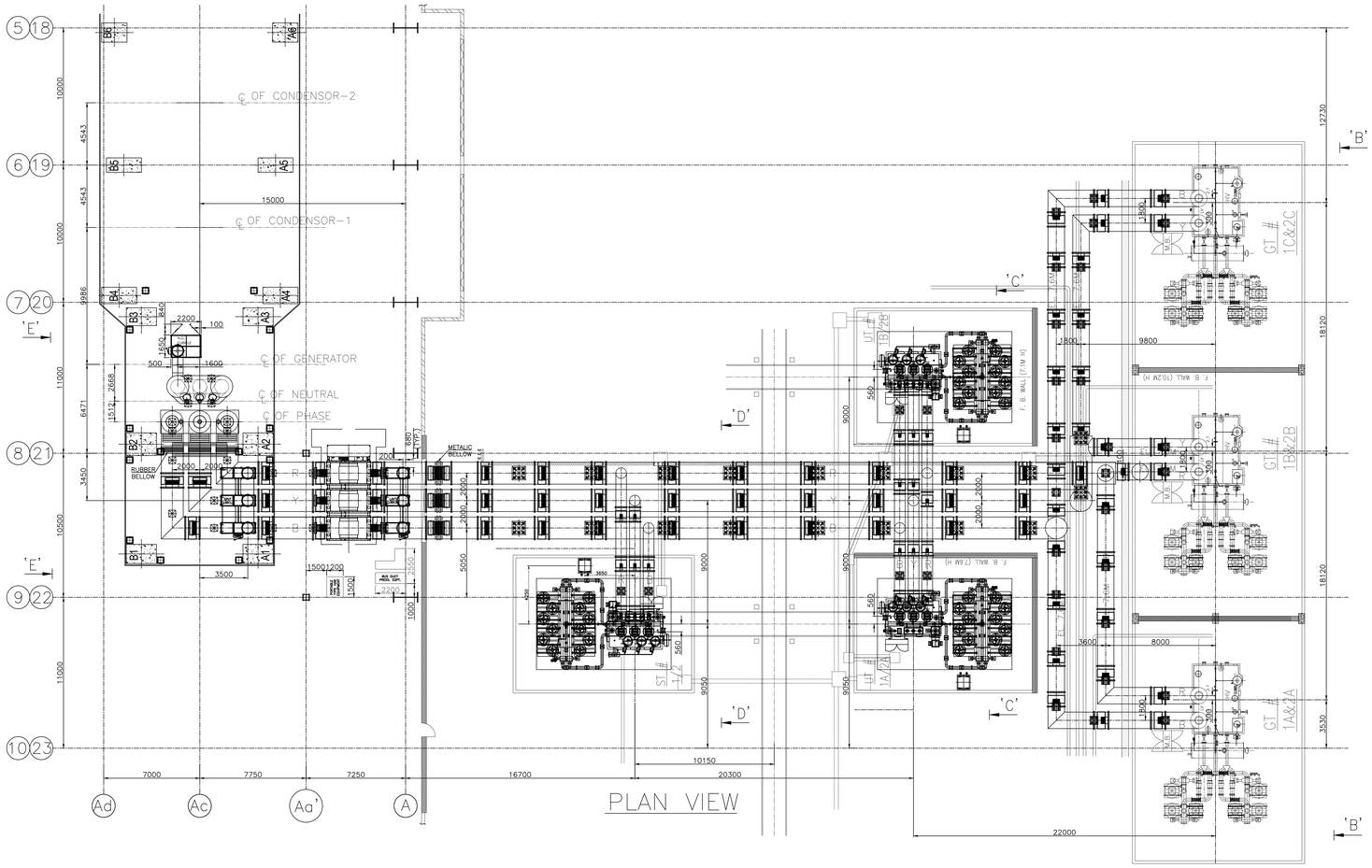
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

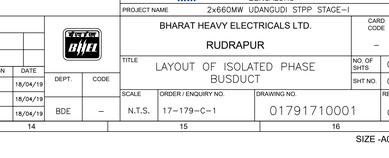


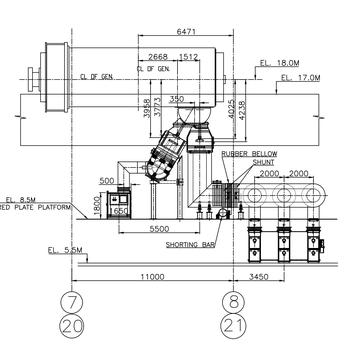


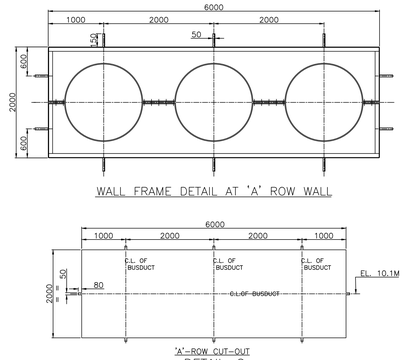












LEGEND:–

- COND. TO COND. WELDED JOINT
- DISCONNECTING LINK
- BOLTED FLEXIBLE JOINT
- MAKE UP PIECE
- C.T.
- SHUNT
- RUBBER BELLOW
- SEAL OFF BUSHING

REFERENCE DRAWINGS/DOCS:–

1. TRANSFORMER YARD LAYOUT	PE–DG–435–100–E001	REV–01
2. SLD FOR GENERATOR PROTECTION	PE–DG–435–510–E001	REV–06
3. O.G.A. OF GEN. TRANSFORMER	BP–DG–435–301–0001	REV–02
4. O.G.A. OF UNIT TRANSFORMER	14560051007	REV–00
5. GENERATOR O.G.A.	01390001479	REV–00
6. O.G.A. OF ST TRANSFORMER	14560051008	REV–00

TATA CONSULTING ENGINEERS LIMITED
VENDOR DRAWING STATUS

	CATEGORY	DESCRIPTION
☐	CAT-1	Drawing/documents approved for final distribution (AFD), will proceed with manufacturing/ construction/installation.
☑	CAT-2	Drawing/documents released for manufacturing/ fabrication/construction subject to incorporating comments indicated. Vendor to submit the final drawing for Approval in Category – 1. Comments will be Tracked on the drawing documents.
☐	CAT-3	Drawing/documents returned for Vendor to Re-submit comment and resubmitted by BHEL for further review/revision.
☐	CAT-4	Drawing/documents received of this category are for information only and not for approval. Information furnished on the document is noted.

Note:
1. It is mandatory to close documents with Code 2 & 3 to Code 1/1A against contract period or 2 weeks, whichever is lower.
2. Vendor to incorporate comments indicated in Code 2 and 4 Drawings / Documents shall be the responsibility of BHEL to resubmit reflecting the Design Changes for information.

Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials, fabrication, performance of equipment and assembly, fits, performance requirements and conformity of supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchaser's rights under the contract.

Reviewed by ..... Date .....

THIS DRAWING WILL BE APPROVED IN CAT-2. FINAL APPROVAL WILL BE GIVEN AFTER VENDOR DRAWINGS, TRANSFORMER/HV/LV, CIVIL DRAWINGS ARE APPROVED UNDER CAT-1.

REV.	DATE	ALTERED
02	18/03/20	SANJAY Kr. GUPTA
		CHECKED
		RUPESH KUMAR

DRAWING REVISED INLINE WITH COMMENTS FROM M/s TCE's Lr. No. TCE.11403A–EL–VDT–356 Dt. 27/01/2020.

REV.	DATE	ALTERED
01	06/01/20	SANJAY Kr. GUPTA
		CHECKED
		RUPESH KUMAR

DRAWING REVISED INLINE WITH LAYOUT OF TRANSFORMER YARD PE–DG–435–100–E001 REV–01.

DISTRIBUTION OF PRINTS

	NAME	SIGN	DATE
DRN	S. DHAWAN		18/04/19
CKD	R. KUMAR		18/04/19
APPD	A. NARAYAN		18/04/19

DEPT. BDE | CODE –

CUSTOMER: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED, TANGEDCO HEAD QUARTERS, 1st FLOOR, NEW EB QTRS, 144, ANNA SALAI, CHENNAI–600002

CONSULTANT: TATA CONSULTING ENGINEERS LIMITED, BENGALURU

PROJECT NAME: 2×660MW UDANGUDI STPP STAGE–I

BHARAT HEAVY ELECTRICALS LTD. | CARD CODE –

RUDRAPUR

TITLE: LAYOUT OF ISOLATED PHASE BUSDUCT | NO. OF SHTS 01 | SHT NO. 01

SCALE N.T.S. | ORDER / ENQUIRY NO. 17–179–C–1 | DRAWING NO. 01791710001 | REV. 02

REF. DRG. NO | SIGN. & DATE | INVENTORY NO.

SIZE –A0

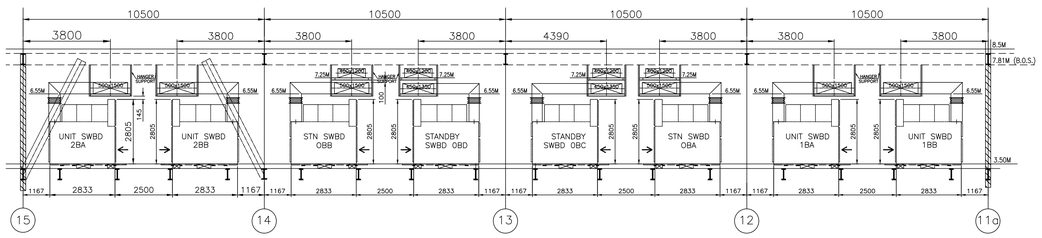
Computer Files:- PCC Rupesh Kumar Folder: D:\UDANGUDI\STG1\PBD\PBD_LAYOUT_REV-02.dwg Printed On 19-03-2020 10:34:13

First Angle Projection

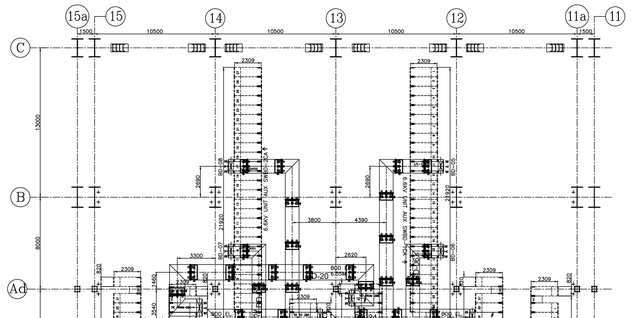
All Dimensions in 'mm'

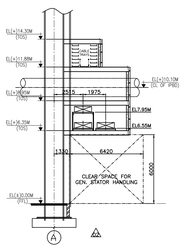
DRAWING NO 02801710001

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.

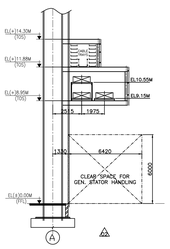


FRONT VIEW OF SWGR ROOM AT A–ROW WALL

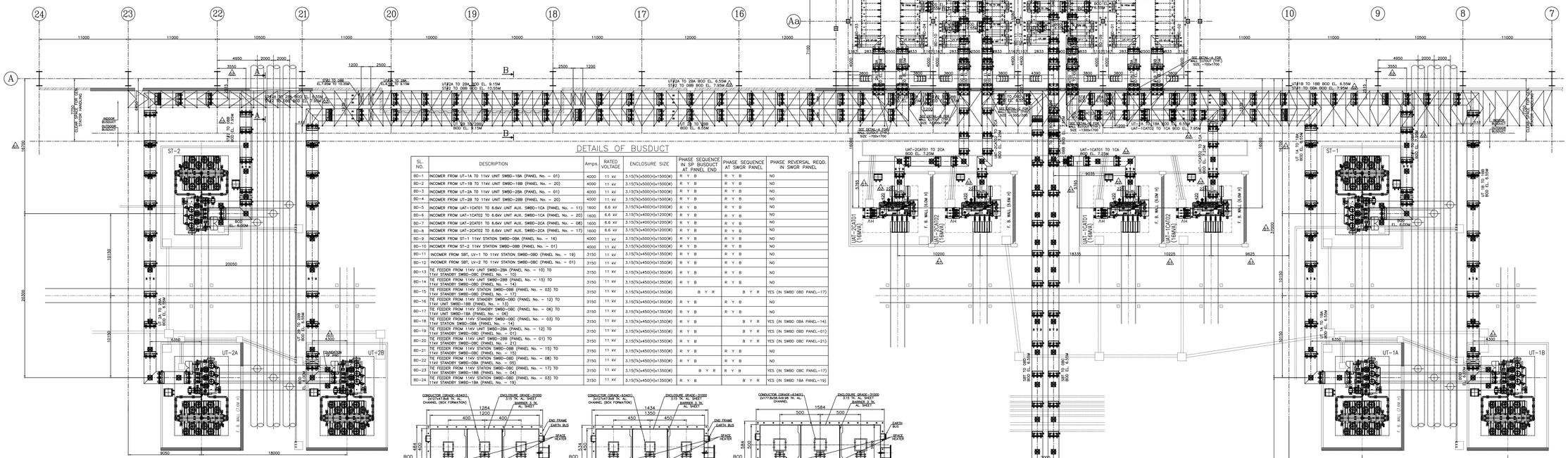




SECTION A–A

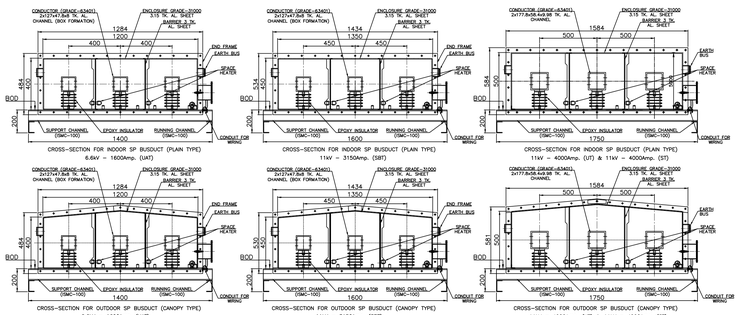


SECTION B–B



DETAILS OF BUSDUCT

SL. NO.	DESCRIPTION	Amps.	RATED VOLTAGE	ENCLOSURE SIZE	PHASE SEQUENCE IN SP BUSDUCT AT PANEL END	PHASE SEQUENCE AT SWGR PANEL	PHASE REVERSAL REQD. IN SWGR PANEL
BD–1	INCOMER FROM UT–1A TO 11kV UNIT SWBD–1BA (PANEL No. – 01)	4000	11 kV	3.15(T)x500(H)x1500(W)	R Y B	R Y B	NO
BD–2	INCOMER FROM UT–1B TO 11kV UNIT SWBD–1BB (PANEL No. – 20)	4000	11 kV	3.15(T)x500(H)x1500(W)	R Y B	R Y B	NO
BD–3	INCOMER FROM UT–2A TO 11kV UNIT SWBD–2BA (PANEL No. – 01)	4000	11 kV	3.15(T)x500(H)x1500(W)	R Y B	R Y B	NO
BD–4	INCOMER FROM UT–2B TO 11kV UNIT SWBD–2BB (PANEL No. – 20)	4000	11 kV	3.15(T)x500(H)x1500(W)	R Y B	R Y B	NO
BD–5	INCOMER FROM UAT–1CAT01 TO 6.6kV UNIT AUX. SWBD–1CA (PANEL No. – 11)	1600	6.6 kV	3.15(T)x400(H)x1200(W)	R Y B	R Y B	NO
BD–6	INCOMER FROM UAT–1CAT02 TO 6.6kV UNIT AUX. SWBD–1CA (PANEL No. – 20)	1600	6.6 kV	3.15(T)x400(H)x1200(W)	R Y B	R Y B	NO
BD–7	INCOMER FROM UAT–2CAT01 TO 6.6kV UNIT AUX. SWBD–2CA (PANEL No. – 08)	1600	6.6 kV	3.15(T)x400(H)x1200(W)	R Y B	R Y B	NO
BD–8	INCOMER FROM UAT–2CAT02 TO 6.6kV UNIT AUX. SWBD–2CA (PANEL No. – 17)	1600	6.6 kV	3.15(T)x400(H)x1200(W)	R Y B	R Y B	NO
BD–9	INCOMER FROM ST–1 11kV STATION SWBD–0BA (PANEL No. – 16)	4000	11 kV	3.15(T)x500(H)x1500(W)	R Y B	R Y B	NO
BD–10	INCOMER FROM ST–2 11kV STATION SWBD–0BB (PANEL No. – 01)	4000	11 kV	3.15(T)x500(H)x1500(W)	R Y B	R Y B	NO
BD–11	INCOMER FROM SBT, LV–1 TO 11kV STATION SWBD–0BD (PANEL No. – 19)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–12	INCOMER FROM SBT, LV–2 TO 11kV STATION SWBD–0BC (PANEL No. – 01)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–13	TIE FEEDER FROM 11kV UNIT SWBD–2BA (PANEL No. – 10) TO 11kV STANDBY SWBD–0BC (PANEL No. – 10)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–14	TIE FEEDER FROM 11kV UNIT SWBD–2BB (PANEL No. – 15) TO 11kV STANDBY SWBD–0BD (PANEL No. – 14)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–15	TIE FEEDER FROM 11kV STATION SWBD–0BB (PANEL No. – 03) TO 11kV STANDBY SWBD–0BD (PANEL No. – 17)	3150	11 kV	3.15(T)x450(H)x1350(W)	B Y R	B Y R	YES (IN SWBD OBD PANEL–17)
BD–16	TIE FEEDER FROM 11kV UNIT SWBD–1BB (PANEL No. – 13) TO 11kV UNIT SWBD–1BA (PANEL No. – 06)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–17	TIE FEEDER FROM 11kV STANDBY SWBD–0BC (PANEL No. – 06) TO 11kV STATION SWBD–0BA (PANEL No. – 14)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	B Y R	YES (IN SWBD OBA PANEL–14)
BD–18	TIE FEEDER FROM 11kV UNIT SWBD–2BA (PANEL No. – 12) TO 11kV STANDBY SWBD–0BD (PANEL No. – 01)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	B Y R	YES (IN SWBD OBD PANEL–01)
BD–19	TIE FEEDER FROM 11kV UNIT SWBD–2BB (PANEL No. – 01) TO 11kV STANDBY SWBD–0BC (PANEL No. – 21)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	B Y R	YES (IN SWBD OBC PANEL–21)
BD–20	TIE FEEDER FROM 11kV STATION SWBD–0BB (PANEL No. – 15) TO 11kV STANDBY SWBD–0BC (PANEL No. – 15)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–21	TIE FEEDER FROM 11kV STATION SWBD–0BA (PANEL No. – 08) TO 11kV STANDBY SWBD–0BA (PANEL No. – 05)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	R Y B	NO
BD–22	TIE FEEDER FROM 11kV STATION SWBD–0BC (PANEL No. – 17) TO 11kV STANDBY SWBD–1BB (PANEL No. – 04)	3150	11 kV	3.15(T)x450(H)x1350(W)	B Y R	R Y B	YES (IN SWBD OBC PANEL–17)
BD–24	TIE FEEDER FROM 11kV STATION SWBD–0BD (PANEL No. – 03) TO 11kV STANDBY SWBD–1BA (PANEL No. – 19)	3150	11 kV	3.15(T)x450(H)x1350(W)	R Y B	B Y R	YES (IN SWBD 1BA PANEL–19)



CROSS–SECTION FOR INDOOR SP BUSDUCT (PLAIN TYPE) 6.6kV – 1600Amp. (UAT)

CROSS–SECTION FOR INDOOR SP BUSDUCT (PLAIN TYPE) 11kV – 3150Amp. (SBT)

CROSS–SECTION FOR INDOOR SP BUSDUCT (PLAIN TYPE) 11kV – 4000Amp. (UT) & 11kV – 4000Amp. (ST)

CROSS–SECTION FOR OUTDOOR SP BUSDUCT (CANOPY TYPE) 6.6kV – 1600Amp. (UAT)

CROSS–SECTION FOR OUTDOOR SP BUSDUCT (CANOPY TYPE) 11kV – 3150Amp. (SBT)

CROSS–SECTION FOR OUTDOOR SP BUSDUCT (CANOPY TYPE) 11kV – 4000Amp. (UT) & 11kV – 4000Amp. (ST)

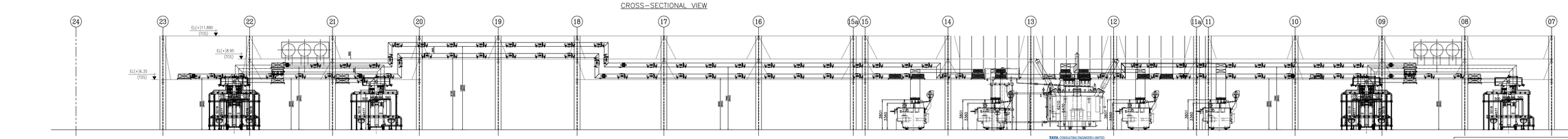
CROSS–SECTIONAL VIEW

PAINT SHADE:–

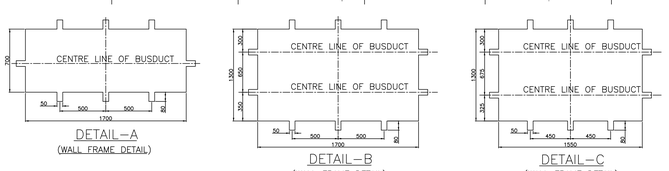
1. CONDUCTOR:–
   INSIDE – NATURAL FINISH
   OUTSIDE – MATT BLACK
2. ENCLOSURE:–
   INSIDE – MATT BLACK
   OUTSIDE – Light Grey (SHADE No. 631 as per IS: 5)

LEGEND:–

- SEAL OFF BUSHING
- SPLICE PLATE
- RUBBER BELLOW
- FLEXIBLE
- INSPECTION WINDOW



ELEVATION



DETAIL–A (WALL FRAME DETAIL)

DETAIL–B (WALL FRAME DETAIL)

DETAIL–C (WALL FRAME DETAIL)

REFERENCE DRAWINGS/DOCS:–

1.	TRANSFORMER YARD LAYOUT	PE–DG–435–100–E001 REV–01
2.	LAYOUT OF MV SWGR ROOM EL. 3.5M	PE–DG–435–100–E002 REV–01
3.	ELE. SLD FOR AUX. POWER DISTRIBUTION	PE–DG–435–565–E001 REV–06
4.	O.G.A. OF UNIT TRANSFORMER	14560051007 REV–00
5.	O.G.A. OF STATION TRANSFORMER	14560051008 REV–00
6.	O.G.A. OF UNIT AUXILIARY TRANSFORMER	14560051011 REV–00
7.	O.G.A. OF STANDBY TRANSFORMER	14600050014 REV–00

TATA CONSULTING ENGINEERS LIMITED
VENDOR DRAWING STATUS

CATEGORY	DESCRIPTION
CAT–1	Drawings/documents approved for shop fabrication/ manufacturing. Manufacturing/ fabrication/ procurement to be done strictly as per these drawings/documents.
☑ CAT–2	Drawing/documents cleared for manufacturing/ fabrication/ procurement. Vendor to incorporate the comments given. Briefly, no resubmit required. Vendor to proceed with manufacturing. Comments will be marked on the drawing/documents.
CAT–3	Drawing/documents not cleared. Vendor to resubmit revised and resubmitted by BHEL for further clearance/approval.
CAT–4	Drawing/documents part of this category are for information only and not for approval. Information/ clarification, if any, to be sought.

Note:
1. It is mandatory to make documents with Code 2 & 3 to Code 1 before commencement of bulk/mass production.
2. Any design changes / modification required to be carried out in CAT–2 & CAT–3 documents should be highlighted in the next submission.
3. In case of doubt, to contact BHEL for any clarification.

Approval conveyed herein neither relieves the Vendor/Contractor of his responsibility for meeting all the requirements of the Contract nor the correctness, clearance of construction, weights, quantities, design details, exactness, fits, performance requirements and conformity of supplies with the requirements of the Contract. Wherever not applicable, we deem it to be the purchaser's rights under the contract.

Reviewed by ..... Date .....

THIS DRAWING WILL BE APPROVED IN CAT–2. FINAL APPROVAL WILL BE GIVEN AFTER VENDOR DRAWINGS, TRANSFORMERYARD, CIVIL DRAWINGS ARE APPROVED UNDER CAT–1.

REV.	DATE	ALTERED	CHECKED
01	06/01/20	SANJAY Kr. GUPTA	RUPESH KUMAR

DRAWING REVISED INLINE WITH COMMENTS FROM M/s TCE and DISCUSSION WITH BHEL PEM
REVISED MV SWGR ROOM LAYOUT PE–DG–435–100–E002 REV–02.

REV.	DATE	ALTERED	CHECKED
01	06/01/20	SANJAY Kr. GUPTA	RUPESH KUMAR

DRAWING REVISED INLINE WITH LAYOUT OF TRANSFORMER YARD PE–DG–435–100–E001 REV–01.

DISTRIBUTION OF PRINTS

	NAME	SIGN	DATE
DRN	S. DHAWAN		20/05/19
CKD	R. KUMAR		20/05/19
APPD	A. NARAYAN		20/05/19

DEPT.	CODE
BDE	–

CUSTOMER: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
TANGEDCO HEAD QUARTERS, 1st FLOOR, NEW EB QTRS, 144, ANNA SALAI, CHENNAI–600002

CONSULTANT: TATA CONSULTING ENGINEERS LIMITED BENGALURU

PROJECT NAME: 2x660MW UDANGUDI STPP STAGE–I

BHARAT HEAVY ELECTRICALS LTD. | CARD CODE –

RUDRAPUR

TITLE: LAYOUT OF SEGREGATED PHASE BUSDUCT | NO. OF SHTS 01 | SHT NO. 01

SCALE	ORDER / ENQUIRY NO.	DRAWING NO.	REV.
N.T.S.	17–180–C–2	02801710001	02

SIZE –A0

Computer Plan:– PC/ Rupesh Kumar/ Path:– C:\Users\RSK\2565\Desktop\SWBD LAYOUT REV–02.dwg Printed On :– 11–03–2020 11:08:54