

VOLUME – IA
Part I & II

TECHNICAL
CONDITIONS OF
CONTRACT
(TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

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VOLUME-IA PART – I CHAPTER – I

PROJECT INFORMATION

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

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VOLUME-IA PART – I CHAPTER – II

C&I WORKS

SCOPE OF WORKS FOR EACH PACKAGE

1.2.1.0	SCOPE OF WORKS-GENERAL:
1.2.1.1	The scope of works covers C&I works of Main Plant (1,2,3 &4) and identified BOP areas of 5x800 MW Yadadri TPS as mentioned below, including supply of labour, tools and plants. The Scope of the works is indicative but not limited to the given below.
1.2.1.2	The scope of works consists of two packages: a. Package-A consists of C&I works of Units 1 & 2 (Main Plant) and identified BOP areas AND b. Package-B consists of C&I works of Units 3 & 4 (Main Plant) and identified BOP areas. (All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)
1.2.2.0	SCOPE OF C&I WORKS FOR EACH PACKAGE:
	A. Preassembly, Erection, Testing and Commissioning, Trial operation and reliability operation of : 1. All types of Field Instruments (Gauges/Switches/Transmitters/Elements) like Temperature, Pressure, Flow (Paddle Wheel/DP/Ultrasonic, etc types of Local/Remote), Level, Density instruments (Local & remote) and special instruments like PD type Mass Flowmeters. 2. All Analyzers-Oxygen, HF, Flue Gas (SOX/NOX/CO), Mercury, NH₃, CO, SOX, NOX & Opacity 3. Vibration Monitoring System, Turbine Supervising Control and Monitoring System 4. Complete SWAS system with analyzers i.e. (Conductivity, Sodium, Iron, Silica, Chloride, Turbidity, Dissolved Oxygen, pH) 5. Microprocessor based flame scanner system, H.E.A Exciter system, Acoustic Steam Leak Detector, Coal Bunker Level Monitor system

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	6. Master Clock system, Large Video Screen System, HART Management System 7. Management Information System, Dynamic Simulator System 8. UPS & Battery System, 9. Wireless communication, Station LAN, OPC Connectivity to all PLC (or) off site DCS 10. All type of Control Room instruments like Recorders, Indicators, Microprocessor based panels, DCS system and its accessories like system panels (Valmet Control Cabinets of SG/TG/BOP/CPU/EIS/T&AVT), Network Panels, Network Enclosures, PCs, Laptops, Printers, Computer Furniture etc. 11. All type of Pneumatic Power Cylinders, Controllers, Limit Switches, etc. 12. All type of Hardware like impulse pipes, Cable trays & tray supports, instrument airline, etc. 13. Laying, termination & testing of all types of power/control/instrumentation cables/Special Cables, etc. 14. Laying & Splicing of Optical Fiber Communication Cables with conduits 15. All UPS, ACDB, Battery, Battery Chargers, DCDB, etc. 16. All type of Local/Remote control panels and LGB,LIE,LIR, Network Enclosures, Junction Boxes, Pushbutton stations. 17. Installation of any other items that have not been specifically indicated, but required for completing installation. B. Testing & Commissioning of the following - Erected by other contractors (includes cabling, tubing, removing, calibrating, testing, etc as required) 1. All types of Pneumatic/Motor Operated Valves/ Actuators/Power Cylinders/Controllers and Relief Valves. 2. Temperature Elements of all the HT Drives

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3. Bidirectional Drives and Unidirectional Drives (HT/LT Drives) & Limit Switches
4. Removal, Calibration and fixing of the instruments in various systems as specified in the BOQ
5. Dosing Systems (Oxygen, NaOH, Ammonia & Hydrazine)
6. Demonstration of the Mechanical and C&I Lab instruments
7. Calibration of instruments at site with the contractor's own calibration and testing equipment under the supervision of BHEL/TSGENCO Engineers.

C. Others:

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

Note:

1. If any peripheral C&I item associated with the above said main equipment which was not erected by other contractor but it is required for complete commissioning shall be erected and commissioned by the contractor. Contractor shall have valid license to carry out the work indicated in the BOQ.

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	2. BHEL will provide OEM's technical support for commissioning of various proprietary type special instruments/systems like Vibration Monitoring System, SWAS, Flue Gas Analyzers, Master Clock System, Coal Bunker Level Monitor, LVS System, HART Management System, Furnace Flame Viewing System, C&I Lab, Wireless Communication, Station LAN, OPC Connectivity to all PLC, etc. The contractor shall carry out the works as per instructions of BHEL/ OEM's Engineer.
1.2.3.0	EXCLUSIONS: The following are specific exclusions from this work. a. Erection of Dampers, Pneumatic/Motor Operated Valves, Electrical Actuators, HT/LT Drives b. Attachment welding of thermocouple pads, Flow Nozzle, Orifice Plates and Control Valves c. Root Valves on the instruments tapping points d. Seal Welding on temperature stub on piping before hydra test. e. Removal of seal welding on temperature stub on piping after successful completion of hydra test. Height of the temp stub to be maintained as per piping drawing. <u>Note:</u> The above exclusions shall not be concluded as final. They are meant for general guidelines. BHEL reserves the right to include or exclude any item which is required for completing the job as per rates indicated in rate schedule. Contractor shall carry out all such jobs as per the instructions of BHEL Site Engineer.
1.2.4.0	The scope of work covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, calibration, checking, erection, testing and commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, PVC sleeves for wire marking, lugs (specific sizes), specific type of fasteners, paints and its consumables. Deployment of skilled / unskilled manpower, engineers /

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	supervisors, T & P, Material handling equipment's, Testing instruments, returning of un-used materials / items to BHEL stores.
1.2.5.0	It is not the intent to specify herein all details of material. Any item related to this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
1.2.6.0	The scope of specification covers the material receipt from BHEL stores, transportation to erection site, installation, testing and commissioning of the electrical equipment, hardware, software (data concentrator) communication along with accessories as detailed in Bill of Materials.
1.2.7.0	If any item or equipment not covered but requires be erected / commissioned, the same shall be carried out by the contractor. Equivalent unit rate for those item or equipment shall be considered wherever possible from the BOM. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.
1.2.8.0	Note: FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT CHAPTERS IN THIS BOOK
Note: Detailed BOM in systems wise and BHEL unit wise with detailed specification of various equipment's and items are given in the VOLUME- IA PART-I CHAPTER-IX . The rate schedule is the summary of BOM i.e. consolidated list of BOM. Contractor shall go through the detailed BOM and specification before filling the rate in the rate schedule.	

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VOLUME-IA PART – I CHAPTER – III FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL (APPLICABLE FOR EACH PACKAGE)

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

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	1.b	Further distribution for the work to be done which include supply of materials and execution		Yes	
	2	Electricity for the office, stores, canteen etc. of the bidder which include		Yes	
	2.a	Distribution from single point including supply of materials and service		Yes	
	2.b	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
	2.c	Duties and deposits including statutory clearances for the above		Yes	
	2.d	Demobilization of the facilities after completion of works		Yes	
	3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc. on the above lines.(in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	
1.3.1.4	D	WATER SUPPLY			
	1	For construction purposes:	Yes		Free of Charges
	1.a	Making the water available at single point	Yes		Free of Charges
	1.b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.5	E	Water supply for bidder's office, stores, canteen etc.			
	1	Making the water available at single point		Yes	
	2	Further distribution as per the requirement of work including supply of materials and execution		Yes	

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1.3.1.6	F	LIGHTING			
	1	For construction work (supply of all the necessary materials) At office storage area, At the preassembly area, At the construction site/area		Yes	
	2	For construction work (Execution of the lighting work/ arrangements) At office Storage Area, At the preassembly area, at the construction site/area		Yes	
1.3.1.7	G	COMMUNICATION FACILITIES for site operations of the bidder			
	1	Telephone, Fax, internet, internet, email etc. (min 2 Nos of PC & Printer) – 2 Data entry operator with computer knowledge		Yes	
1.3.1.8	H	COMPRESSED AIR SUPPLY			
	1	Supply of Compressor and all other equipment required for compressor & compressed air system including pipes, valves, storage systems etc		Yes	
	2	Installation of above system and operation & maintenance of the same		Yes	
	3	Supply of the all the consumables for the above system during the contract period		Yes	
1.3.2.0	PART-B -ERECTION FACILITIES				
		Engineering works for construction			
	1	Providing the erection drawings for all the equipment covered under this scope	Yes		In consultation with BHEL
	2	Drawings for construction methods		Yes	In consultation with BHEL

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	3	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	In consultation with BHEL
	4	Shipping lists etc for reference and planning the activities	Yes	Yes	In consultation with BHEL
	5	Preparation of site erection schedules and other input requirements		Yes	
	6	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments	Yes		In consultation with BHEL
	7	Weekly erection schedules based on SI No. 6		Yes	In consultation with BHEL
	8	Daily erection / work plan based on SI No. 7		Yes	In consultation with BHEL
	9	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
	10	Preparation of preassembly bay		Yes	
	11	Laying of racks for gantry crane if provided by BHEL or brought by the contractor/bidder themselves			Not Applicable
1.3.3.0	LAND				
1.3.3.1	Minimum Open space will be provided at free of charges to the contractor within the plant premises or adjacent to the plant boundary for construction of temporary office shed, contractor's stores shed(s). Contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated for un- insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for their site office, covered store or any other temporary building.				

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	Alternatively, contractor can adopt readymade 'porta cabin" or similar construction.
1.3.3.2	BHEL shall not provide to the contractor any residential accommodation to any of their staff and the contractor has to make their own arrangements. Only Land for Labour colony and staff colony will be provided by BHEL adjacent to the plant boundary to contractor at free of cost. Contractor has to make their own arrangements for labour colony.
1.3.3.3	Contractor has to furnish the details of requirements of area of space for their office, stores, storage shed, labour colony etc. at site before starting the work to BHEL Site Engineer.
1.3.3.4	Location and area requirement for office / storage sheds / fabrication yard shall be discussed and mutually agreed to.
1.3.4.0	ELECTRICITY:
1.3.4.1	The construction power (415V) will be provided at a single point for construction purpose free of charge. Construction power shall be provided from the nearest Substation / tapping point within the plant premises. For the purpose of measurement of power consumed, the contractor shall provide Energy meter with valid calibration certificate. Distribution from this source to different locations is to be arranged by the bidder at their cost.
1.3.4.2	Electricity for labour colony and staff colony will be provided at single point on chargeable basis at the prevailing rate of TSGENCO. Distribution from this source to different locations is to be arranged by the bidder at their cost.
1.3.4.3	Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards to contractor's office shed also, all such expenditure shall be borne by the contractor. Demand charges if any to be borne by the contractor.
1.3.4.4	Provision of distribution of electrical power from the given points to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State/ BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.
1.3.4.5	BHEL is not responsible for any loss or damage to the contractor 's equipment as a result of variations in voltage / frequency or interruptions in power supply.
1.3.4.6	Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.8 shall be provided by the contractor at their cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.
1.3.4.7	Contractor has to make their own arrangements for their electricity requirement for their labour colony at their cost incase Electricity is not provided by TSGENCO.

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1.3.4.8	As there are bound to be interruptions in regular power supply, power cut/load shedding in any construction sites, contractor should make their own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown /failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency
1.3.5.0	CONSTRUCTION WATER
1.3.5.1	Water (Raw water) required for construction purposes will be provided at one single point within the plant area at free of charge for construction purpose and bidder has to make their own arrangement for further distribution by arranging required pipes, valves, pumps, etc.
1.3.5.2	Water (Raw water) for labour colony and staff colony shall be provided at single point on chargeable basis at the prevailing Government Tariff and bidder has to make their own arrangement for further distribution by arranging required pipes, valves, pumps, etc.
1.3.5.3	Incase non-availability of water, the contractor shall make their own arrangements of water suitable for construction purpose to have uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply. Contractor has to make their own arrangements for their water requirement for their labour colony at their cost.
1.3.6.0	DRINKING WATER: Bidder shall provide drinking water at the work spot at their cost.
1.3.7.0	ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS] per package:
1.3.7.1	Contractor has to provide at BHEL office, minimum two (02) computers and printers along with refilling of cartridges whenever required (along with one operator per PC) for online material management, reporting of daily progress, billing and other similar activities, within the quoted rate. Computers shall have minimum configuration of minimum Windows 7 OS, 4GB RAM and Internet Explorer 8 or above.
1.3.8.0	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.

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1.3.8.2	All the required electrodes (in their scope) as approved by BHEL shall be arranged by contractor at their cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement regarding, suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc.
1.3.8.3	All electrodes including stainless steel electrodes required for shall be arranged by the contractor at their cost. The bidder shall use the Customer approved quality welding electrodes only.
1.3.8.4	The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including alloy steel and stainless steel), all gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding and pre-assembly materials, hardware items etc. required for temporary works such as supports, scaffoldings, bed are to be arranged by them. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by them.
1.3.8.5	All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.
1.3.8.6	In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same at the risk and cost of the contractor. The entire cost towards this along with standard BHEL overhead shall be deducted from the contractor's immediate due bills.
1.3.9.0	MATERIAL SUPPLY:
1.3.9.1	BHEL will supply the materials/equipment indicated in the weight schedule, supplied from their respective manufacturing units which are to be executed/incorporated in the permanent system.
1.3.10.0	POSSESSION OF GENERATORS:

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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 per Package 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.
1.3.11.0	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.
1.3.12.0	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.
1.3.13.0	ELECTRODES SUPPLY AND STORAGE:
1.3.13.1	The bidder shall use the BHEL / Customer approved quality welding electrodes only.
1.3.13.2	It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement, regarding suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc.

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1.3.13.3	Shortage of any of the electrodes or the equivalent suggested by BHEL shall not be quoted as reason for deficiency in progress or for additional rate. Contractor shall submit weekly/ fortnightly/ monthly statement/ report regarding consumption and available stock of all types of electrodes for avoiding stoppage of work on consumable scarcity.
1.3.13.4	Storage of electrodes shall be done in an air conditioned / controlled humidity room as per requirement, at their own cost by the contractor.
1.3.13.5	All low hydrogen electrodes shall be baked / dried in the electrode drying oven (range 375 deg. C - 425 deg. C) to the temperature and period specified by the BHEL Engineer before they are used in erection work and each welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by contractor at their cost.
1.3.13.6	In case of improper arrangement of procurement of above electrodes BHEL reserves the right to procure the same from any source and recover the cost from the contractor's first subsequent bills at market value plus departmental charges of BHEL communicated from time to time. Postponement of such recovery is not permitted.
1.3.13.7	BHEL reserves the right to reject the use of any electrodes at any stage, if found defective because of bad quality, improper storage, date expiry, unapproved type of electrodes etc. It shall be the responsibility of the contractor to replace at their cost without loss of time.
1.3.14.0	OTHER FACILITIES:
1.3.14.1	Adequate waterless urinals [at least 2 nos per level] shall be arranged by the contractor within quoted rates, at site of construction at different level and different areas like boiler structure, with proper disposal arrangement.
1.3.15.0	MATERIALS /CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR AT THEIR COST FOR ERECTION AND COMMISSIONING OF RESPECTIVE EQUIPMENTS/ITEMS.
1.3.15.1	All welding electrodes, filler wires, gases shall be arranged by the contractor at their cost.
1.3.15.2	Supply of paints, Ferrules, lugs for sizes up to 2.5 sq mm shall be in the scope of the contractor within the quoted rate.
1.3.15.3	Other items:
	1. Provision for Temporary scaffoldings
	2. Insulation tapes
	3. Paints required for primer coating & final coating and for protective coating. paint of approved colour, consumables like thinner brushes, emery paper etc.,

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	4. Solder wire (Lead 60/40)	
	5. Protocol / calibration report sheets as per BHEL format	
	6. PVC wire marker sleeves and tag plates	
	7. Panel / JB sealing compound material (for cable entry from bottom / top of panel)	
	8. Materials required for cable dressing (GI / Aluminium Flats, PVC Cable ties, etc)	
	9. Anchor fasteners for wall mounted cable trays & JBs wherever required.	
	10.PVC wire marker sleeves and tag plates	
	11. Lugs of size 2.5 sq.mm and below	
	12. “U” clamps with nuts and washers for impulse pipes and GI pipe clamping.	
	13. Tag Plats-Al/Fiberglass/Stainless Steel	
	14. Insulation Tapes	
	15. Teflon Tap for GI pipe coupling	
	16. Protocol/Calibration report sheets as per BHEL format	
	17. Fastener for mounting JB, Local PB boxes and earthing flats.	
	18. PVC cable tie, Aluminium or GI strips and fasteners for clamping of cables and other dressing materials required for cable dressing, grommet sleeves for cables.	
1.3.16.0	TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS	
1.3.16.1	CABLE LUGS:	
	Type	Solderless Crimping Type
	Material	Copper/ Aluminium
	Whether Tinning required (for copper cable lugs)	Yes
	Thickness of Tinning	10 Microns
	Applicable Standard for LT cables	IS:8309
1.3.16.2	FERRULES:	
	Colour of Ferrules	Yellow/White
	Colour of Engraving	Black
1.3.16.3	TAGS:	
	Material	Al/Fiberglass/Stainless Steel
	Markings	Engraving/Embossing/Printing
1.3.17.0	POWER REQUIREMENT:	
1.3.17.1	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.	
1.3.18.0	CONTRACTOR’S OBLIGATION ON COMPLETION:	

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

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VOLUME-IA PART – I CHAPTER – IV

T&PS AND MMES TO BE DEPLOYED BY CONTRACTOR (APPLICABLE FOR EACH PACKAGE)

1.4.0.0	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.																																																														
1.4.1.0	The following minimum Instruments / T&P shall be arranged by contractor in sufficient number to carry out the job simultaneously in more than one area. A. List of Recommended Instruments for Erection, Testing & Commissioning.																																																														
	<table><tr><th>Sl.No.</th><th>Description</th><th>Quantity</th></tr><tr><td>01</td><td>Dead Weight tester rated 600 kg/sq.cm with weights & test gauges facility.</td><td>02 Nos.</td></tr><tr><td>02</td><td>Oil temperature bath suitable to calibrate upto 400° C</td><td>02 Nos.</td></tr><tr><td>03</td><td>Furnace range 600 Deg C</td><td>01 No.</td></tr><tr><td rowspan="9">04</td><td>Standard Pressure Gauges as below :</td><td></td></tr><tr><td>0 to 1 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 5/6 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 10 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 16 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 25 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 60 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 100 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>0 to 250 kg/Sq.cm</td><td>01 No.</td></tr><tr><td rowspan="4">05</td><td>Standard Temperature Gauges as below :</td><td></td></tr><tr><td>0 to 100 Deg C</td><td>02 No.</td></tr><tr><td>0 to 200 Deg C</td><td>02 No.</td></tr><tr><td>0 to 600 Deg C</td><td>02 No.</td></tr><tr><td>06</td><td>Standard compound pressure gauge -1 to +3 kg/Sq.cm</td><td>02 No.</td></tr><tr><td>07</td><td>Standard Vacuum Gauge -760 mm Hg to 0 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>08</td><td>Portable air compressor with drier and regulator rated for 10 kg/Sq.cm</td><td>01 No.</td></tr><tr><td>09</td><td>Manometer 0 to 1000 mm WC with hand bulb</td><td>03 Nos.</td></tr><tr><td>10</td><td>Vacuum pump with standard vacuum gauge</td><td>01 No.</td></tr><tr><td>11</td><td>Standard Milliamps Source (Digital)</td><td>03 Nos.</td></tr><tr><td>12</td><td>Standard Millivolts Source (Digital)</td><td>03 Nos.</td></tr></table>	Sl.No.	Description	Quantity	01	Dead Weight tester rated 600 kg/sq.cm with weights & test gauges facility.	02 Nos.	02	Oil temperature bath suitable to calibrate upto 400° C	02 Nos.	03	Furnace range 600 Deg C	01 No.	04	Standard Pressure Gauges as below :		0 to 1 kg/Sq.cm	01 No.	0 to 5/6 kg/Sq.cm	01 No.	0 to 10 kg/Sq.cm	01 No.	0 to 16 kg/Sq.cm	01 No.	0 to 25 kg/Sq.cm	01 No.	0 to 60 kg/Sq.cm	01 No.	0 to 100 kg/Sq.cm	01 No.	0 to 250 kg/Sq.cm	01 No.	05	Standard Temperature Gauges as below :		0 to 100 Deg C	02 No.	0 to 200 Deg C	02 No.	0 to 600 Deg C	02 No.	06	Standard compound pressure gauge -1 to +3 kg/Sq.cm	02 No.	07	Standard Vacuum Gauge -760 mm Hg to 0 kg/Sq.cm	01 No.	08	Portable air compressor with drier and regulator rated for 10 kg/Sq.cm	01 No.	09	Manometer 0 to 1000 mm WC with hand bulb	03 Nos.	10	Vacuum pump with standard vacuum gauge	01 No.	11	Standard Milliamps Source (Digital)	03 Nos.	12	Standard Millivolts Source (Digital)	03 Nos.	
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13	Mercury Manometer different range	04 Nos.
14	DC Power Supply , 24 V ; 5A	03 Nos.
15	Single Phase Variac 250V; 10A	01 Nos.
16	Glass Thermometers of ranges in Deg C as below : 0-120 ; 0-200; 0-600	02 Nos. each
17	Tong tester AC 5/10/25 ; KEW Snap Make	01 No. each
18	Function Generator	01 No.
19	Hand Operated Megger 500V ; 2.5 kV / 100 M Ohms	Each type As required
20	Torque wrench	As required
21	AC Voltmeter 0-125 ; 250 ; 625V	01 No. each
22	AC Ammeter 0-2A ; 10A	01 No. each
23	Analog Multimeter Motwane Make	03 Nos.
24	Digital Multimeter 3 1/2 Digit	08 Nos.
25	Digital Multimeter 4 1/2 Digit	03 Nos.
26	Wire wrapping tool	As required
27	Oscilloscope	01 Nos.
28	Soldering irons, soldering pump, Vacuum cleaner, Air blower etc.	As required

B. List of Recommended Tools & Plants

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

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	20	Flood light fittings	As required		
	21	Fire extinguishers	As required		
	22	Distribution boards with power cable complete as required with energy meter	As required		
	23	Hydraulic test pump rating 750 kg/sq.cm	As required		
	24	Painting brush	As required		
	25	Fire proof tarpaulin	As required		
	26	Safety belts & safety helmets	As required		
	27	Telephone sets	As required		
Note:					
a. T & Ps and their quantity as mentioned in above list are the suggestive requirement considering parallel working. However, its mobilization, quantity and period of T&Ps deployment will be mutually agreed at site as per actual requirement.					
b) Numbers / time of requirement will be reviewed from time to time at site and contractor will provide required T&Ps / equipment to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL.					
c) Vendor will give advance intimation prior to its dispatch. Also on completion of the respective activity, demobilization of T&Ps in total or in part can be done with the due approval of engineer in charge. Retaining of the T&Ps during the contract period will be mutually agreed in line with construction requirement.					
1.4.2.0	ACCURACY REQUIREMENT OF TESTING INSTRUMENTS				
	Sl.No.	Instrument / Tool	Range	Accuracy	Dial Size
01		Digital Multimeter	Voltage 200 mV to 1000 V DC	± 1% + 1 digit	
			Philips Voltage 200 mV to 1000 V AC	± 1% + 1 digit	
			Philips Current 20 mA to 20 A AC	± 0.8% + 1 digit	
			Resistance (HCl) 2120 200* to 20 M*	± 0.5% + 1 digit	
			Resistance (Hcl) 2105 200* to 200M*	± 0.25% + 3 digits	
			Hcl Voltage 200 mV to 750 V	± 0.8% + 1 digit	
			Philips Current 20 mA to 20 A DC	± 0.5% + digit	
			Hcl Current 200 mA to 010 A AC	± 1% + digit	
02			Voltage 2.5 to 2500V AC	± 1.0%	

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		Analog Multimeter	Current 100 mA to 10A AC	± 2.0%	
			Current 250 micro A to 1A DC	± 1.5%	
			Resistance upto 100 ohms	± 3.0%	
			Voltage 2.5 V to 2500 V	± 1 %	
	03	MV/mV Source	0 to 200 mA / 200mV	0.2%	
	04	Hand operated Megger 500V /1000 V	Upto 200 m Ohms	± 5% at Centre scale	10"
	05	Standard Pressure Gauges	0 to 1 kg/cm ²	±0.25% LC– 0.02 kg/ cm ²	10"
			0 to 6 kg/cm ²	±0.25% LC– 0.1 kg/ cm ²	10"
			0 to 10 kg/ cm ²	±0.25% LC– 0.02kg/ cm ²	10"
			0 to 25 kg/ cm ²	±0.25% LC– 0.25kg/ cm ²	10"
			0 to 60 kg/ cm ²	±0.25% LC– 0.1kg/ cm ²	10"
			0 to 250 kg/ cm ²	±0.25% LC– 2.5kg/ cm ²	10"
			0 to 400 kg/ cm ²	±0.25% LC– 2.5 kg/ cm ²	10"
			0 to 600 kg/ cm ²	±0.25% LC– 2.5 kg/ cm ²	10"
			0 to 1000 kg/ cm ²	±0.25% LC– 1.0 kg/ cm ²	10"
	06	Dead Weight Tester	0 to 400	LC – 5 kg/cm ²	
			0 to 600	LC – 5 kg/cm ²	
	07	Standard Hg in glass Thermometer	0 to 100°C	LC - 1°C	
			0 to 110°C	LC - 1°C	
			0 to 250°C	LC - 1°C	
			0 to 150°C	LC - 1°C	
			0 to 360°C	LC - 1°C	

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		0 to 420°C	LC - 1°C	
08	Single Phase Variac	15 A Capacity	N/A	
09	Power Pack	0 to 50 V DC, 3A	± 2%	
10	Vibration Measuring Equipments	Velocity up to 50 mm/sec	± 0.5% mm/sec	
		Displacement upto 300 microns	± 2 microns	
11	Tongue tester	0/300/600 A AC	± 5%	
		0 to 300 A DC	± 5%	
12	Tacho Meter (Hand held)	0 to 4000 rpm	± 5%	
13	Phase Sequence Meter		N/A	
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	± 5% at Centre Scale range	
15	DC Ammeter	0 to 300 A	± 10%	
16	DC Voltmeter	0 to 500 V	± 10%	

Note:

1. For loading and transportation, all necessary T & P such as Trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor. All the tools & plants required for this scope of work, except the tools & plants provided by BHEL are to be arranged by the contractor within the quoted rates.
2. **Note for Contractor's Instruments:**
 - a. The contractor shall arrange all the above T&P, equipment and instruments as indicated except testing instruments which are proprietary in nature.
 - b. The contractor at their cost shall arrange all cranes and truck / tractor, trailers required for material handling purpose and also cranes required for erection.
 - c. Any other tools and plants instruments and equipment required in addition to the above for the successful completion of this job will have to be arranged by the contractor at their cost.
 - d. Necessary accessories for the above shall also be provided by the contractor.
 - e. The above instruments / equipment will be sent for testing and calibration wherever from time to time and maintained by contractor as required by BHEL.

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	f. All testing instruments shall have calibration certificate issued by recognized / accredited agencies. g. List of such agencies and periodicity of calibration required for different instruments will be furnished by BHEL at site. h. Contractor shall maintain calibration records as per the BHEL format and produce them whenever called for by BHEL Engineers. i. Contractors shall arrange experienced/qualified persons for using these calibration instruments at laboratory and also at work spot. j. Wherever frequent calibration is required; contractor shall arrange adequate number of instruments such that the work does not suffer for want of test instruments.
1.4.3.0	T&Ps mentioned above is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers / time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipment to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL. Vendor will give advance intimation and certification regarding capacity etc. prior to dispatch of heavy equipment. Also on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement.
1.4.4.0	Computerized ferrules printing machine (min – 01 No.) shall be provided for making printed ferrules for all the cables.
1.4.5.0	PROTECTION / HANDLING OF TOOLS AND PLANT ARRANGED BY THE CONTRACTOR
1.4.5.1	Equipment, vehicles, tools and plants and materials brought to site by the contractor from their resources shall have distinctive identification marks and the contractor shall intimate the description and quantity to BHEL in writing.
1.4.5.2	All construction materials brought by the contractor shall have prior approval regarding quality and quantity by BHEL. The contractor shall also provide without extra cost necessary enclosures containers and protective materials for proper storage of materials inside, whenever so instructed by the purchaser without any extra cost.
1.4.5.3	No material or equipment or tools etc., shall be taken out of the work-site without the written consent of BHEL.

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1.4.5.4	BHEL shall not be responsible for the safety and protection of the materials of the contractor and the contractor shall make their arrangements for proper watch and ward for their materials.
1.4.5.5	Until such time the work is taken over by BHEL, the contractor shall be responsible for proper protection including proper fencing, guarding, lighting, flagging, and watching. The contractor shall during the progress of work properly cover up and protect any part of the work liable to damage by exposure to the weather and shall take every reasonable precaution against accident or damage to the work from any cause.
1.4.5.6	In the event of non-mobilisation of Tools, Plants, Machinery, Equipment, Material or non-availability of the same owing to breakdown and as a result progress of work suffered, BHEL reserves the right to make alternative arrangement (available or higher capacity) in line with SCC clause no. 4.2.1.7 and hire charges shall be applicable as under: i. BHEL provides its own Capital T&P: If BHEL provides owned T&P then BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges applicable (as enclosed in Volume I Book I TCC- Volume IA Part II) as per following cases: • In case the T&P is specifically listed in “T&Ps to be deployed by Contractor”, ‘Rates of hire charges applicable to outside agencies other than contractors working for BHEL’ will apply. • In case the T&P is not specifically listed in “T&Ps to be deployed by Contractor”, ‘Rates of hire charges applicable to contractors working for BHEL’ will apply. The hire charges of Capital Tools & Plants are exclusive of operating expenses e.g., Operator, fuel & Consumables and the same shall be arranged by the contractor at their cost. ii. BHEL provides hired T&P: In all cases other than that specified in Sl. No. (i) above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor.
1.4.6.0	CALIBRATION RECORD OF SUB-CONTRACTOR'S INSTRUMENTS Format No. CP:PEX:FOX Name of Site: Name of Sub-Contractor:

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

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VOLUME-IA PART – I CHAPTER – V

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

(APPLICABLE FOR EACH PACKAGE)

1.5.0.0	T&Ps AND MMEs TO BE DEPLOYED BY BHEL ON SHARING BASIS
1.5.1.0	List of T&Ps to be made available by BHEL to contractor free of hire charges on sharable basis. 1. EOT Crane at the respective TG Hall without operator– 01 No.
1.5.2.0	EOT crane without operating personnel shall be made available in the TG Hall free of charge. The contractor has to arrange operator for EOT Crane. EOT crane will be allocated for execution of C&I work including shifting the panels within power house building on sharing basis at free of hire charges. The decision of BHEL Engineers will be final with regard to allotment of crane.
1.5.3.0	Experienced Crane operator for EOT crane to be arranged by the bidder at their cost.
1.5.4.0	Providing manpower assistance required for free movement of Trailing cable of EOT Crane is also scope of the bidder at their cost.
1.5.5.0	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.
1.5.6.0	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.
1.5.7.0	Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
1.5.8.0	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.
1.5.9.0	Contractor shall make good any loss or damage to the equipment's supplied to them and day to day maintenance and operations of

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	equipment's shall be borne by the contractor including all consumables like petrol, oil and air filters etc.,
1.5.10.0	BHEL may provide either BHEL owned or hired 75T (or above capacity) cranes as per site requirement for erection at the discretion of BHEL.
1.5.12.0	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.
1.5.13.0	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.
1.5.14.0	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.
1.5.15.0	Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional T & Ps which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at their cost. In case if the contractor fails to provide such equipment, BHEL

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	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.
1.5.16.0	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.
1.5.17.0	All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections shall have to be arranged by the contractor at their cost.
1.5.18.0	Necessary electrical / water / air connection required for operation of any of the tools & tackles shall be in the Contractor's scope.
1.5.19.0	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.
1.5.20.0	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.
1.5.21.0	For movement of cranes etc., it may become necessary to lay sleeper bed for obtaining leveled safe approach for usage of equipment. It shall be the responsibility of the contractor to lay necessary sleeper's. The sleepers shall be arranged by the contractor at their cost.
1.5.22.0	The contractor at their cost shall arrange for grouting of anchor points of T&Ps issued to them. Necessary grout materials are to be arranged by the contractor at their cost.
1.5.23.0	In case of non-availability of any of these equipment, due to any reason i.e., unavoidable breakdown, major overhaul or any other reason etc., the contractor should make arrangement at their cost to meet the erection targets. No extra claim will be admitted due to non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.

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VOLUME-IA PART – I CHAPTER-VI

TIME SCHEDULE (APPLICABLE FOR EACH PACKAGE)

1.6.0.0	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.																					
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.																					
1.6.2.0	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.																					
1.6.3.0	MOBILIZATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIONING ETC.,																					
1.6.3.1	The activities for erection, testing etc. shall be started as per directions of Construction manager of BHEL. The contractor has to augment their resources in such a manner that following major milestones of erection & commission are achieved on specified schedules: <table><tr><th colspan="3">A. Major Milestones</th></tr><tr><th>Milestone Activity (for each package)</th><th>Package – A</th><th>Package – B</th></tr><tr><td>1. Start of work</td><td>1st Month</td><td>1st Month</td></tr><tr><td>2. Readiness for Boiler Light Up</td><td>5th month (first unit) 7th Month (later unit)</td><td>5th month (first unit) 7th Month (later unit)</td></tr><tr><td>3. Readiness for Synchronization</td><td>9th Month (first unit) 11th Month(later unit)</td><td>9th Month (first unit) 11th Month(later unit)</td></tr><tr><td>4. Trial Operation</td><td>14th Month (both Units)</td><td>14th Month (both Units)</td></tr><tr><td>5. Balance work completion, pending</td><td>20th Month (both Units)</td><td>20th Month (both Units)</td></tr></table>	A. Major Milestones			Milestone Activity (for each package)	Package – A	Package – B	1. Start of work	1 st Month	1 st Month	2. Readiness for Boiler Light Up	5 th month (first unit) 7 th Month (later unit)	5 th month (first unit) 7 th Month (later unit)	3. Readiness for Synchronization	9 th Month (first unit) 11 th Month(later unit)	9 th Month (first unit) 11 th Month(later unit)	4. Trial Operation	14 th Month (both Units)	14 th Month (both Units)	5. Balance work completion, pending	20 th Month (both Units)	20 th Month (both Units)
A. Major Milestones																						
Milestone Activity (for each package)	Package – A	Package – B																				
1. Start of work	1 st Month	1 st Month																				
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3. Readiness for Synchronization	9 th Month (first unit) 11 th Month(later unit)	9 th Month (first unit) 11 th Month(later unit)																				
4. Trial Operation	14 th Month (both Units)	14 th Month (both Units)																				
5. Balance work completion, pending	20 th Month (both Units)	20 th Month (both Units)																				

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	points, punch points liquidation		
	B. Intermediate Milestones		
	Milestone	Package – A	Package – B
	1. Readiness for Boiler Light Up of the first unit (M1)	5 th Month	5 th Month
	2. Readiness for Synchronization of later unit (M2)	11 th Month	11 th 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.		
1.6.4.0	PENALTY FOR INTERMEDIATE MILESTONES FOR EACH PACKAGE		
1.6.4.1	M1 and M2 shall be intermediate 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		

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	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.
1.6.5.0	CONTRACT PERIOD
1.6.5.1	The contract period for completion of entire work for each package under scope shall be 20 (Twenty) months from the “COMMENCEMENT OF CONTRACT PERIOD” as specified earlier.
1.6.6.0	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 later Unit to Customer (or) Six months from the date of first synchronization of the later unit, whichever is earlier. (Provided all erection, testing, commissioning and pending points works are completed in all respects).

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TERMS OF PAYMENT

(APPLICABLE FOR EACH PACKAGE)

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

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

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

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Note:

1. Retention amount as per Cl. 2.22 of GCC (Volume IC).
2. RA bill payments as per Chapter-X of SCC (Volume IB).
3. Base date for the purpose of calculation of PVC for this contract (inline with Cl.No. 2.17.5 of GCC) shall be as follows.
Base date shall be calendar month of the scheduled completion date (i.e. actual start date + scheduled contractual completion period as per letter of intent/award and or work order).
4. Secured advance and advance for mobilization is not applicable for this contractor.

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

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TAXES AND DUTIES

1.8.1 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 be as below:
BHEL GSTN - 36AAACB4146P1ZG
NAME - BHARAT HEAVY ELECTRICALS LIMITED
ADDRESS - Yadadri Thermal Power Station, 5X800 MW (Coal based), Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana, India
- 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.

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- 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 favour of BHEL. No other variations shall be allowed during the tenure of the contract.
- 1.8.4 New Taxes/Levies
In case Government imposes any new levy / tax after submission of bid during the tenure of the contract, BHEL shall reimburse the same at actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract.
- 1.8.5 Direct Tax
BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

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A.1.6.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJF23/24-CAF20/21, CJF25/26- CAF22/23 & CJF27/28-CAF24/25 & CJF29/30-CAF26/27	Nos	4	4
A.1.7.1	Suit of five Cubicles Size: 3750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 2000 kg. CJF01,02,03,04,05 & CJF58,59,60,61,62	Nos	2	2
A.2.0	Shifting from Stores to UCR, placement & erection of TG Package- (Non-Core) Valmet DNA control cabinets			
A.2.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CJJ08, CJJ41 & CWW01	Nos	3	3
A.2.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CCA10 & CCA11	Nos	1	1
A.2.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJJ03,CJJ04 & CJJ53	Nos	1	1
A.2.4	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJJ01,02,05,06, CCA01,02,03,04, CJJ20,21,22,23 & CJJ30,31,32,33	Nos	4	4
A.2.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of TG Package- (Non-Core) Valmet DNA control cabinets			
A.2.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CJJ08, CJJ41 & CWW01	Nos	3	3
A.2.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CCA10 & CCA11	Nos	1	1
A.2.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJJ03,CJJ04 & CJJ53	Nos	1	1
A.2.4.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJJ01,02,05,06, CCA01,02,03,04, CJJ20,21,22,23 & CJJ30,31,32,33	Nos	4	4
A.3.0	Shifting from Stores to UCR, placement & erection of STN C&I Valmet DNA Control Cabinets			
A.3.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CRE61/CTE01/CTE02/CTE03	Nos	4	4
A.3.2	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE04	Nos	1	0
A.3.3	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE51/52, CRE81/82, CRE53/54, CRE83/84, CRE55/56, CRE57/58, CRE59/60	Nos	7	7

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A.3.4	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE85/86	Nos	1	0
A.3.5	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRE41/42/43, CRE48/49/50, CRE62/63/64, CRE65/66/67, CRE68/69/70	Nos	5	5
A.3.6	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRW01-03, 04-06, 11-13, 71-73, 74-76	Nos	5	0
A.3.7	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRR91-93,94-96 & 97-99	Nos	3	0
A.3.8	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRE 01-04,05-08, 09-12,13-16,17-20,21-24,25-28,29-32,33-36,37-40,44-47	Nos	11	11
A.3.9	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRW07-10	Nos	1	0
A.3.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of STN C&I Valmet DNA Control Cabinets			
A.3.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CRE61/CTE01/CTE02/CTE03	Nos	4	4
A.3.2.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE04	Nos	1	0
A.3.3.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE51/52, CRE81/82, CRE53/54, CRE83/84, CRE55/56, CRE57/58, CRE59/60	Nos	7	7
A.3.4.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE85/86	Nos	1	0
A.3.5.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRE41/42/43, CRE48/49/50, CRE62/63/64, CRE65/66/67, CRE68/69/70	Nos	5	5
A.3.6.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRW01-03, 04-06, 11-13, 71-73, 74-76	Nos	5	0
A.3.7.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRR91-93,94-96 & 97-99	Nos	3	0
A.3.8.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRE 01-04,05-08, 09-12,13-16,17-20,21-24,25-28,29-32,33-36,37-40,44-47	Nos	11	11
A.3.9.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRW07-10	Nos	1	0
A.4.0	Shifting from Stores to UCR, placement & erection of CPU C&I Valmet DNA Control Cabinets			

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A.4.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE11, CTE12, CTE14 & CTE15	Nos	4	0
A.4.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRA10/11	Nos	1	0
A.4.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRA01-03, 04-06, 12-14	Nos	3	0
A.4.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of CPU C&I Valmet DNA Control Cabinets			
A.4.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE11, CTE12, CTE14 & CTE15	Nos	4	0
A.4.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRA10/11	Nos	1	0
A.4.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRA01-03, 04-06, 12-14	Nos	3	0
A.5.0	Shifting from Stores to UCR, placement & erection of SCR C&I Valmet DNA Control Cabinets			
A.5.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB01-03 & 04-06	Nos	2	2
A.5.2	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB11-13 & 14-16	Nos	2	0
A.5.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of SCR C&I Valmet DNA Control Cabinets			
A.5.1.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB01-03 & 04-06	Nos	2	2
A.5.2.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB11-13 & 14-16	Nos	2	0
A.6.0	Shifting from Stores to UCR, placement & erection of T&AVT/EIS Control Cabinets & Network Panels/Network Enclosures			
A.6.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CFA01	Nos	1	0
A.6.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CXA01-02 & 03-04	Nos	1	0
A.6.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CXA03-05	Nos	1	0
A.6.4	EIS Control Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CYJ01	Nos	1	1
A.6.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of T&AVT/EIS Control Cabinets & Network Panels/Network Enclosures			

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A.6.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CFA01	Nos	1	0
A.6.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CXA01-02 & 03-04	Nos	1	0
A.6.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CXA03-05	Nos	1	0
A.6.4.1	EIS Control Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CYJ01	Nos	1	1
A.6.0.2	Erection and Commissioning of Network Panels and Network Enclosures.			
A.6.0.2.1	Network Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP11/21/41	Nos	3	3
A.6.0.2.2	Network Panel (LAN-I/II) of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP51/52	Nos	1	0
A.6.0.2.3	Network Panel (Common System) of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP31/32/33/35/36/37	Nos	2	0
A.6.0.2.4	Network Enclosures for LAN & BOP Systems of Size: 600 mm(W) X 500 mm(D) x 600 mm(H); Approx. weight 20 kg.	Nos	18	0
A.7.0	TURBINE SUPERVISORY SYSTEM FOR MAIN TURBINE			
A.7.1	Meggitt VM600 system with 19" Rack Control Cabinet- 2 Nos. (with power supply unit, back panel, CPU module, I/O cards, relay cards, protection cards), TFT monitors, server, A3 Colour printer, Ethernet to FO convertor, interconnecting cables, etc. Approx. Size and Weight of the Panel 750 x 800 x 2117 mm; 400 kg.	Set	1	1
A.7.2	Total loose supplied items to be mounted in the cabinet is as follows: Absolute Bearing Vibration sensors with isolators qty: 16; Relative Shaft Vibration sensors with isolators qty: 16; Absolute shaft expansion (HP & LP Rotor) with isolators qty: 4 each; Axial shaft/shaft position with isolators qty: 3; Reference phase measurement sensors with isolators qty: 1 No and Junction boxes qty: 12 Nos.	Set	1	1
A.8.0	HART MANAGEMENT SYSTEM (SUPERVISION OF E&C BY OEM)			
A.8.1	Hart Management System (HMS) Comprising of the following: HART Panel- 02 Nos., Workstation PC with 24" TFT Monitor-02 Nos., Colour laser Printer 01 No., and other loose supplied items like Hart / back plane communication modules, Patch cards/ 20 way FRC intra panel cables 69 set, RS485/RS232 Convertor, interconnecting Cables, etc. Approx. Size and Weight of the Panel 800(L) x 800(W) x 2415(H) mm; 400 Kg each.	Set	1	1

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A.9.0	INSTRUMENTS			
A.9.1	Pressure Transmitter	Nos	297	195
A.9.2	Differential Pressure Transmitter	Nos	147	128
A.9.3	Ultrasonic type level transmitter	Nos	69	27
A.9.4	Flow Transmitter (DP type)	Nos	129	121
A.9.5	Guided Wave Radar Type Level Transmitter	Nos	24	24
A.9.6	Temperature Elements	Nos	330	330
A.9.7	Pressure Gauge	Nos	244	151
A.9.8	Differential Pressure Gauge	Nos	24	20
A.9.9	Pressure and Differential Pressure switches	Nos	60	60
A.9.10	Temperature Gauge	Nos	130	130
A.9.11	Level Gauge	Set	1	1
A.9.12	Level Switch- Conductivity Type for CRH drain pots consists of two nos of level probes, field mounted electronic control units-1 No., interconnecting cables 10 mtr	Nos	4	4
A.9.13	Coal Bunker Level Monitoring System - 3D Scanner on Bunker top, 2 Nos. Panel at Bunker Floor/Unit, 1 No. Computer in CER/Unit.	Set	8	8
A.9.14	I/P Converters for Burner Tilt & SADC	Nos	33	33
A.10.0	FLUE GAS ANALYZERS			
A.10.1	High temperature Oxygen Analyzer (in situ type) make: SECO; Consisting of insitu, flange mounted zirconium oxide type probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	2	2
A.10.2	Low temperature Oxygen Analyzer (in situ type) make: AICPL; Consisting of insitu, flange mounted zirconium oxide type probe and electronics-1 cabinet, Auto Calibration unit for three calibration cylinders, Zero span and one span cylinders along with accessories, 2/1 metre probe protectors and wall mounted panel for Analyzer. App.weight of analyser is 22 Kg	Set	11	9
A.10.3	CO Analyser (In-Situ type) Consisting of CO Sensor head , High Temperature Probe (1800 mm app.), Protection tube (1800 mm app.), Temperature/Pressure Transmitters, Digital Display Unit, Air Dryer panel (App. size 760x760x210 mm), Power Supply Unit, Calibration Gas Cylinder filled with CO & Nitrogen, Pressure Switch for purge air blower, Air compressor-1 No. & connecting cables. App. weight of analyser is 22 kg.	Set	6	6
A.10.4	HF analyser Consists of Process & Purge tubes (1500 mm app.)-02 Nos, Transmitter/Receiver units-02 Nos, HF Gas Analyser Unit-01 No., Analyser Panel	Set	1	1

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	(App.Size 600x600x2000 mm)-01 No. (Wt. 200 kg), Air Purification unit-01 No., Power Supply unit-01 No., Canopies for Transmitter/Receiver/Power Supply unit (as applicable), Purge air unit-01 No., fail safe shutter with 10 mtr cable, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.			
A.10.5	Opacity Analyser (In Situ type) Consisting of Transceiver unit -02 No each with air purge connections, Signal processor unit, power supply unit, display control unit, fail safe shutter with 10 mtr cable against power or purge air failure, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.	Set	1	1
A.10.6	SOX/NOX/CO (Combined) analyser system Consisting of in-situ dilution Probe (long 1500 mm) flange mounted, umbilical cord 1x1/4 inch teflon & 3 x 1/4th nylon pvc jacketing 100 mtr long , span/back flush, dilution air, Dilution control unit with auto calibration solenoids, pressure gauges, flow meter, air dryer with filter arrangement, calibration gas cylinders 10 ltr capacity 4 sets with rack stand, Analyser panel (800mm x 800mm x 1915mm) fitted air condition & 19 inch racks, tubing & sampling panel + analysers. The tubing/ signal, control, power cabling between probe and Analyser panel is approx 100 mtrs long, 800 mmx 2100 mm (H). The probe is located at approx. 82 mt Elevation on chimney+ flue. Local PC based DAS consist of 24-inch monitor, i3 processor with key board and accessories.	Set	1	1
A.10.7	Mercury analyser consist of sample probe with heated filter, mounting flange, heated sample tubes with RTD (length 50 mtrs), span zero gas calibration cylinders, peristaltic pumps 2 nos, outdoor PLC panel size 1200mm(w) x 600mm (d) x 2000mm (h) aprox weight of panel 300 Kg, mounted on chimney at 41 mtr elevation.	Set	1	1
A.10.8	Gas Flow analyser (InSitu non-contact Cross duct type) Consisting of Transceiver unit -02 No each with air purge connections, Signal processor unit, power supply unit, display control unit, fail safe shutter with 10 mtr cable against power or purge air failure, Air	Set	1	1

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	Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.			
A.11.0	STEAM AND WATER ANALYSIS (SWAS): The scope of work includes erection of main system along with the equipments and loose items indicated below, if any, interconnection pipes between cooler, chiller and wet panel, cooling water connection pipes between cooler, chiller and wet panel etc.			
A.11.1	Sample Handling System: Sampling handling system consisting of: a. Primary Rack # 1: 01 Nos.Dim.1500(L)x800(D)x2100(H) in mm) App.overall weight 400 kg. b. Primary Rack # 2: 01 Nos.Dim.700(L)x800(D)x2000(H) in mm) App.overall weight 200 kg. c. Self Standing Racks # 3/4: 02 Nos. (App. Dim.600(L)x600(D)x1800(H) in mm) App.overall weight 150 kg. d. Wet panel:01 No.(App.Dim.5000 (L)x1600 (D)x2115(H) in mm) App.weight: 3000 kg. e. Analyser panel:01 No.(App. Dim.6500(L)x800(D)x2115(H) in mm) App.overall weight 2000 kg. f. Self Standing Rack (Sampling Skid) # 5: 01 Nos. (App. Dim.2500(L)x1500(D)x2200(H) in mm) App.overall weight 850 kg. g. Self Standing Racks # 6: 01 Nos. (App. Dim.800(L)x800(D)x2000(H) in mm) App.overall weight 200 kg. h. Chiller unit (redundant):01 No. (App. Dim 2200(L)x1200(D)x1275(H) in mm) and App.Overall weight: 850 kg.	Set	1	1
A.11.2	Sampling Sensors and Devices: The following analysers and sensors are to be assembled in the above said panels (or) as per the direction of BHEL Site engineer. a. Specific Conductivity Analysers: 08 Sets b. Cation Conductivity Analysers: 5 Sets c. pH Analysers: 10 Sets d. Dissolved O2 Analysers: 5 Sets e. Silica Analysers: 02 Sets f. Sodium Analysers: 01 Sets g. Chloride Analysers: 01 Set h. Turbidity Analysers: 01 Set i. Iron Analysers: 01 Sets j. Degassed Cation Conductivity Analyzers-02 Sets k. Hydrazine Analyser - 02 Sets	Set	1	1

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A.11.3	A 106 Gr. 2" NB SCH 40 for Cooling water for SWAS includes Tees and bends	Mtrs	140	140
A.11.4	SS316, 2" NB SCH 40 for Cooling water for SWAS includes Tees and bends	Mtrs	60	60
A.11.5	Tubing with connectors (SS316 1/4" OD) Between wet and dry panel	Mtrs	420	420
A.11.6	Special cables for sensors between wet and dry panel	Mtrs	1100	1100
A.11.7	Laying and Termination of Power Cables to SWAS Panel/Chiller	Mtrs	50	50
A.12.0	VIBRATION MONITORING SYSTEMS			
A.12.1	Vibration Monitoring System for SG&TG at CER:			
A.12.1.1	Bearing Casing Vibration Sensors with block/pad & 10 Metre extension cables.	Set	166	166
A.12.1.2	Non-Contact type Probe (Shaft Biv+Axial Shift+Phase Marker) along with extension cable & drive mounting brackets and probe Holders:	Set	67	67
A.12.1.3	Junction boxes	Nos	127	127
A.12.1.4	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	8	8
A.12.1.5	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	2	1
A.12.1.6	Three Bay VMS panel App. Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg.	Nos	1	1
A.12.1.7	VMS Server/User PC	Nos	2	2
A.12.1.8	Printer	Nos	1	1
A.12.1.9	Ethernet Cable	Mtrs	200	200
A.12.2	Vibration Monitoring System for CWP/ACWP at CWP Control Room:			
A.12.2.1	Bearing Casing Vibration Sensors with block/pad & 10 Metre extension cables:	Set	57	57
A.12.2.2	Non-Contact type Probe (Shaft Biv+Axial Shift+Phase Marker) along with extension cable & drive mounting brackets and probe Holders:	Set	2	2
A.12.2.3	Junction boxes	Nos	37	37
A.12.2.4	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	2	2
A.12.2.5	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	1	1
A.12.2.8	FO Cable	Mtrs	1200	1200
A.12.2.9	Ethernet Cable	Mtrs	100	100
A.12.3	Vibration Monitoring System for APH Wash Pumps at Clarified Water Pump House and RW Pumps at RWPB Control Room:			
A.12.3.1	Bearing Casing Vibration Sensors with block/pad & 10 Metre extension cables:	Set	72	0
A.12.3.2	Non-Contact type Probe (Shaft Biv+Axial Shift+Phase Marker) along with extension cable & drive mounting brackets and probe Holders:	Set	7	0
A.12.3.3	Junction boxes	Nos	49	0

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A.12.3.4	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	6	0
A.12.3.5	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	2	0
A.12.3.6	FO Cable	Mtrs	6300	0
A.12.3.7	Ethernet Cable	Mtrs	100	0
A.13.0	UPS WITH ACDB & BATTERY BANK			
A.13.1	Main Plant & St-I & II: 2 X180 KVA UPS parallel redundant comprising of the following: UPS-1 , UPS 2, Rectifier Panel, inverter panels and Aux panel 1,2 ,with Input also. Transformer overall size 6400 mm (L) x 1000 mm(W) x 2100 mm(H) aprox weight 8000 Kg. wall mounted Battery isolation JB's size 600mm x 300mm x800mm weight 80 Kg aprox. Wall mounted BHMS Display boxes aprox size 450mm x 500mm x 150mm and accessories.	Set	2	1
A.13.2	415 V ACDB of size app. 6400(L)x1000(W)x2100(H) in mm and app. Wt. 850 kg.	Nos	2	2
A.13.3	Laying of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) from UPS to Battery	Mtrs	600	600
A.13.4	Laying of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) UPS to ACDB	Mtrs	1200	1200
A.13.5	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	50
A.13.6	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	5460	5460
A.13.7	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	2
A.13.8	UPS BATTERY: 1285 AH/ 360 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 433(L) x 368(W) x 682(H). App.Cell weight without electrolyte: 134 Kg & 204 kg with electrolyte. Total Qty of electrolyte: 21000 litre.	Set	2	2
A.13.9	RWPH: 2 X10 KVA UPS parallel redundant comprising of thefollowing: UPS-1 , UPS 2, Rectifier Panel, inverterpanels and Aux panel 1,2 ,with Input Iso. Transformeroverall size 2200 mm (L) x 900 mm(W) x 1870 mm(H)aprox weight 3000 kg. wall mounted Battery isolation JB'ssize 600mm x 300mm x800mm weight 80 Kg aprox. Wallmounted BHMS Display boxes aprox size 450mm x 500mmx 150mm and accessories.	Set	1	0

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A.13.10	415 V ACDB of size app. 750(L)x300(W)x1250(H) in mm and app. Wt. 200 kg.	Nos	2	0
A.13.11	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Mtrs	160	0
A.13.12	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Mtrs	60	0
A.13.13	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	0
A.13.14	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	3360	0
A.13.15	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	0
A.13.16	UPS BATTERY: 200 AH/ 220 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 134(L) x 203(W) x 406(H). App.Cell weight without electrolyte: 13.5 Kg & 21 kg with electrolyte. Total Qty of electrolyte: 1600 litre.	Set	1	0
A.13.17	FOPH/FOUS: 2 X10 KVA UPS parallel redundant comprising of the following: UPS-1 , UPS 2, Rectifier Panel, inverter panels and Aux panel 1,2 ,with Input Iso. Transformer overall size 2200 mm (L) x 900 mm(W) x 1870 mm(H) aprox weight 3000 kg. wall mounted Battery isolation JB's size 600mm x 300mm x800mm weight 80 Kg aprox. Wall mounted BHMS Display boxes aprox size 450mm x 500mm x 150mm and accessories.	Set	1	0
A.13.18	415 V ACDB of size app. 750(L)x300(W)x1250(H) in mm and app. Wt. 200 kg.	Nos	2	0
A.13.19	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Mtrs	160	0
A.13.20	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Mtrs	60	0
A.13.21	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	0
A.13.22	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	3360	0
A.13.23	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	0
A.13.24	UPS BATTERY: 200 AH/ 220 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly	Set	1	0

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	and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 134(L) x 203(W) x 406(H). App.Cell weight without electrolyte: 13.5 Kg & 21 kg with electrolyte. Total Qty of electrolyte: 1600 litre.			
A.13.25	Power Distribution Boards for Gas Cl2/PT Plant App.Dimension 400(L)x300(W)x600(H) and app. Wt. 500 kg.	Nos	2	0
A.13.26	SMALL UPS SYSTEM			
A.13.26.1	1 kVA UPS System 230 V output, 30-90 min back up with 2/3 pin power socket with auto voltage regulator	Nos	5	0
A.14.0	LOCAL INSTRUMENT ENCLOSURES/RACKS			
A.14.1	Local Instrument Enclosures (Type - A)-Size: 1450(W) x 1000(D) x 2200 (H)mm; Approximate weight: 900 kg each	Set	22	20
A.14.2	Local Instrument Enclosures (Type - B)-Size: 1100(W) x 1000(D) x 2200 (H)mm; Approximate weight: 600 kg each	Set	40	36
A.14.3	Local Instrument Enclosures (Type - C)-Size: 700(W) x 1000(D) x 2200 (H)mm; Approximate weight: 400 kg each	Set	26	20
A.14.4	Local Instrument Racks (Type - A)-Size: 1400(W) x 650(D) x 2200(H) mm; Approximate weight: 600 kg each	Set	26	24
A.14.5	Local Instrument Racks (Type - B)-Size: 1100(W) x 650(D) x 2200(H) mm; Approximate weight: 400 kg each	Set	47	42
A.14.6	Local Instrument Racks (Type - C)-Size: 800(W) x 650(D) x 1500(H) mm; Approximate weight: 250 kg each	Set	24	18
A.14.7	Local Instrument Racks (Type - D)-Size: 1600(W) x 650(D) x 2200(H) mm; Approximate weight: 700 kg each	Set	7	6
A.15.0	LAYING AND TERMINATION OF CABLES			
A.15.1	Thermocouple Extension Cables			
A.15.1.1	2 Pair, 16 AWG, KX Type TC Extension Cable	Mtrs	10620	10620
A.15.1.2	6 Pair, 16 AWG, KX Type TC Extension Cable	Mtrs	29295	29295
A.15.1.3	2 Pair, 16 AWG, RX Type TC Extension Cable	Mtrs	2000	2000
A.15.2	Extruded HRPVC with FRLS, Armoured, Over All Shielded, Copper Cables			
A.15.2.1	2 pair x 0.5 sqmm	Mtrs	9270	9270
A.15.2.2	4 pair x 0.5 sqmm	Mtrs	25290	25290
A.15.2.3	8 pair x 0.5 sqmm	Mtrs	14535	13770
A.15.3	Extruded HRPVC with FRLS, Armoured, Individually and overall shielded, Copper Cables			
A.15.3.1	2 pair x 0.5 sqmm	Mtrs	11970	10890
A.15.3.2	4 pair x 0.5 sqmm	Mtrs	37876	36526
A.15.3.3	6 pair x 0.5 sqmm	Mtrs	600	600
A.15.3.4	8 pair x 0.5 sqmm	Mtrs	8055	8055
A.15.3.5	12 pair x 0.5 sqmm	Mtrs	2000	2000

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A.15.3.6	2 Troid x 0.5 sqmm	Mtrs	11677	11677
A.15.4	Extruded HRPVC with FRLS, Armoured, Copper control Cables			
A.15.4.1	3 C x 2.5 sqmm	Mtrs	6615	2520
A.15.4.2	5 C x 2.5 sqmm	Mtrs	3330	3330
A.15.5	TG Special Cables			
A.15.5.1	Special Cable 5 x1.5 sqmm	Mtrs	1000	1000
A.15.5.2	FEP Insulated 2x2x0.5 sqmm type-1 Cable	Mtrs	5400	5400
A.15.5.3	FEP Insulated 2x4x0.5 sqmm type-2 Cable	Mtrs	2000	2000
A.15.5.4	CAT 6/Ethernet UTP Cable	Mtrs	17700	12200
A.15.5.5	Laying of Optic Fiber cable for offsite PLC/ DCS systems and MIS connectivity	Mtrs	30000	10000
A.15.5.6	HDPE Conduits for laying OFC cables	Mtrs	6000	6000
A.15.5.7	Splicing of Optical Fibre Cable	Nos	350	200
A.16.0	CABLE TRAYS			
A.16.1	50 mm Perforated Trays with Cover	Mtrs	1500	1500
A.16.2	100 mm Perforated Trays with Cover	Mtrs	1500	1500
A.16.3	50 mm Perforated Trays without Cover	Mtrs	2000	2000
A.16.4	100 mm Perforated Trays without Cover	Mtrs	2000	2000
A.17.0	JUNCTION BOXES			
A.17.1	12 way JB	Nos	23	16
A.17.2	24 way JB	Nos	68	54
A.17.3	36 way JB	Nos	30	30
A.17.4	48 way JB	Nos	32	22
A.17.5	64 way JB	Nos	5	5
A.17.6	72 way JB	Nos	2	2
A.17.7	96 way JB	Nos	6	6
A.17.8	128 way JB	Nos	5	5
A.18.0	IMPULSE PIPES, FITTINGS, MANIFOLDS AND ACCESSORIES.			
A.18.1	ASTM A335 P91 - 1/2" NB 160	Mtrs	865	865
A.18.2	ASTM A106 Gr C - 1/2" NB SCH 160	Mtrs	2422	2422
A.18.3	ASTM A106 Gr C - 1/2" NB SCH 80	Mtrs	8217	8217
A.18.4	ASTM A106 Gr C - 1" NB SCH 80	Mtrs	259	259
A.18.5	ASTM A106 Gr C - 3/4" NB SCH 80	Mtrs	6568	6568
A.18.6	ASTM A335 P22 - 3/4" NB SCH 80	Mtrs	1038	1038
A.18.7	ASTM A312 TP316- 1/2" NB SCH 40	Mtrs	242	242
A.18.8	ASTM A312 TP316H - 1/2" NB SCH 80	Mtrs	605	605
A.18.9	ASTM A312 TP316H - 1/2" NB SCH 160	Mtrs	951	951
A.19.0	INSTRUMENT VALVES AND ACCESSORIES			
A.19.1	FGV A105 :1/2" NB-SW 800	Nos	7	7
A.19.2	FGV ASTM A182 F91 :1/2"NB-SW 3000SPL	Nos	5	5
A.19.3	FGV ASTM A182 F22 :1/2"NB-SW, CL-1500	Nos	11	11
A.20.0	MASTER AND SLAVE CLOCK SYSTEM			
A.20.1	Reduntant GPS Based Master Clock System (Card Rack System) along with Fully wired Master clock System Panel (App.Size: 800 x 800 x 2415 mm; wt. 300 kg) - 01 No., power supply unit, battery system,	Set	1	0

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	signal boosters, Signal Conditioners, multiplexer, FO Accessories (LIU, Duplex etc.)			
A.20.2	42 U Panel of size 800 mm (L)x1000mm(W)x2115(H)for housing the servers, network switches	Nos	1	0
A.20.3	Slave clock (Rs 485 based)/NTP based Approximate Size: 750(W) x56(D) x 170(H) mm for various locations	Nos	25	0
A.20.4	Reduntant GPS antenna (built in LA) along with around 200 Mtrs antenna cable from antenna to GPS receiver unit and antenna fixing accessories.	Set	2	0
A.20.5	Reduntant GPS Receiver/Master Clock-A and Master Clock-B with comparator and out put cards.	Set	1	0
A.20.6	Laying and termination of RG 58 Coaxial Cable FRLS armoured (Clock panel to IRIG B interfacing equipment and Clock panel to various pulses interfacing equipments)	Mtrs	5000	0
A.20.7	Laying and termination of Armoured Power Cable 3Cx2.5 sqmm	Mtrs	3600	0
A.20.8	Laying and termination of Armoured Signal Cable 2Px0.5 sqmm	Mtrs	5400	0
A.20.9	Cable - CAT 5e/CAT6 for NTP / SNTP output	Mtrs	280	0
A.20.10	FO Cable (4F) connecting FO NTP outpus multimode armoured cable	Mtrs	3500	0
A.20.11	Splicing of Optical Fibre Cable	Nos	10	0
A.20.12	Flexible GI conduit Pipe	Mtrs	200	0
A.20.13	Junction Boxes	Nos	8	0
A.21.0	LARGE VIDEO SCREEN SYSTEMS			
A.21.1	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height / arrangement etc. in Unit Control room	Set	11	5
A.21.2	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for AHP system.	Set	4	0
A.21.3	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for CHP system.	Set	4	0

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A.21.4	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for FOPH system.	Set	2	0
A.22.0	HMI & PIS SYSTEM PACKAGE			
A.22.1	HMIPIIS for Unit DDCMIS			
A.22.1.1	Operator WorkStation	Nos	40	10
A.22.1.2	Historical Storage & Retrieval (Information) WorkStation	Nos	2	2
A.22.1.3	Programmer cum documentation station	Nos	2	2
A.22.1.4	LaserJet Colour Printer (A4 size)	Nos	3	3
A.22.1.5	LaserJet B/W Printer (A4 size)	Nos	3	3
A.22.2	HMIPIIS for AHP DDCMIS			
A.22.2.1	Operator WorkStation	Nos	2	0
A.22.2.2	Programmer cum documentation station	Nos	2	0
A.22.2.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.3	HMIPIIS for CHP DDCMIS			
A.22.3.1	Operator WorkStation	Nos	2	0
A.22.3.2	Programmer cum documentation station	Nos	2	0
A.22.3.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.4	HMIPIIS for Mill Reject System			
A.22.4.1	Operator WorkStation	Nos	1	0
A.22.4.2	Programmer cum documentation station	Nos	1	0
A.22.4.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.5	HMIPIIS for FOPH			
A.22.5.1	Operator WorkStation	Nos	2	0
A.22.5.2	Programmer cum documentation station	Nos	2	0
A.22.6	HMIPIIS for CPU			
A.22.6.1	Operator WorkStation	Nos	1	0
A.22.6.2	Programmer cum documentation station	Nos	1	0
A.22.7	HMIPIIS for CW/ACW SYSTEM			
A.22.7.1	Operator WorkStation	Nos	4	0
A.22.7.2	Programmer cum documentation station	Nos	3	0
A.22.7.3	LaserJet Colour Printer (A4 size)	Nos	3	0
A.22.8	HMIPIIS for Compressed Air System			
A.22.8.1	Operator WorkStation	Nos	1	0
A.22.8.2	Programmer cum documentation station	Nos	1	0
A.22.8.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.23.0	Performance Analysis Diagnostics and Optimization (PADO) Package			
A.23.1	Computer Table	Nos	3	3
A.23.2	Chairs	Nos	3	3
A.23.3	Printer Table	Nos	1	1
A.24.0	LAB INSTRUMENTS - To be demonstrated and handing over to Customer			
A.24.1	Lab Instruments - I:			

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A.24.1.1	Dead Weight Tester - 2 Nos, Standard Quality Pressure Gauges - 3 Set, Laboratory Type Manometer - 2 Set, Inclined Tube Manometer - 2 Set, Manometer - 2 Set, Pressure and Vacuum Air Pump - 2 Set, Portable Pressure Comparator - 1 Set, Temperature Calibration Bath - 1 Nos, Temperature Calibrator - 3 Nos, Temperature Calibrator (Table Mounted) - 2 Nos, Hot air Blower - 1 Nos, Barometers - 1 Nos, Surface Pyrometer - 1 Nos, Pneumatic Test Bench - 2 Nos, Portable Flue Gas Analyser - 1 Set, Furnace - 1 Nos, Mercury Thermometer - 2 Set, Tool Kit Box - 12 Nos, Oil Condition Monitor - 1 Nos, Portable Ultrasonic Flowmeter - 2 Nos, Wet & Dry Bulb Hygrometer - 1 Nos, Flowmeter Calibration - 1 Set, Air Sets - 1 Nos, Welding Machine - 1 Nos, Jewellers Lathe - 1 Nos, Grinding Machine - 1 Set, Feeler Gauge - 1 Nos, Anemometer (Portable) - 1 Nos, Stop Watch - 1 Nos, Vibration Calibrator - 1 Nos, Precision Instrument Radial Drilling Machine - 3 Nos, Portable Drilling Machine - 1 Nos, Universal Digital Thermometer - 1 Nos, Low and Medium Pressure Controller - 1 Set, Portable Pneumatic Hydraulic Calibrator - 1 Set, Bench Vice & Hand Vice - 3 Set, Vacuum Cleaner - 1 Nos, Screw Gauge - 1 Nos, Pitot Tube - 2 Nos, Test Thermocouple - 2 Nos.	SET	1	0
A.24.2	Lab Instruments-II:			
A.24.2.1	Portable Multifunction Calibrator (Microprocessor based) - 3 Nos, Decade Resistance Box - 2 Nos, AC Universal Bridge - 1 Nos, Signal Generator - 2 Nos, Hand Tachometer - 2 Nos, Insulation tester of Different range - 1 Nos, DC Regulated Power Supply - 4 Nos, Stop Watch (Digital Type) - 2 Nos, Continuity Tester - 10 Nos, Tong Tester - 3 Nos, High Range Tong Tester - 1 Nos, Stabilised Power Supply - 2 Nos, Stroboscope - 1 Nos, Portable Trend Recorder - 1 Nos, Electronic Test Bench with computerized calibration system - 2 Nos, Digital Oscilloscope - 2 Nos, Decade Resistance Box - 2 Nos, Digital Multimeter - 2 Nos, Function Generator - 2 Nos, Chartless Recorder - 2 Nos, Variable DC Stabilized Power Supply - 2 Nos, Variable AC Stabilized Power Supply (0-260 V, 10A) - 2 Nos, Step Down Transformer (110V, 2A) - 2 Nos, Continuity Tester - 2 Nos, Fixed Power Supply (+/- 48 V DC, 3A, +/- 24V DC, 6A, +/- 12V DC, 10A, +/- 5V DC, 5A) - 2 Nos, Electronically Operated Air Gun - 2 Nos, Digital LCR-Q Bridge - 2 Nos, Card IC Tester - 2 Nos, Soldering Station & Desoldering Station - 2 Nos, Power meter with Harmonic Analysis - 2 Nos, One set of tool box with screw driver set, Spanner, Plier Cutter - 2 Nos, Portable digital multimeter - 10 Nos, Field	SET	1	0

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	Transmitter Calibrator - 2 Nos, Soldering Iron with Solder Sucker - 8 Nos, DE Soldering Station - 1 Nos, VARIAC - 1 Nos, Power Pack - 2 Nos, Vibration Analyzer Balancer Instrument - 2 Nos, Portable Meter Calibrator - 2 Nos, Digital Cable Identification System - 6 Nos, Dual Beam Portable Digital Storage Oscilloscope - 2 Nos, Hand Held Thermocouple and PT-100 Ohm Simulator and Indicator - 1 Nos, Insertion and Extraction tools for various Pin Numbers 14,16 and 48 - 2 Nos, Rheostats - 1 Nos, Desktop Digital Multimeter - 2 Nos, Phase Sequence Meter - 1 Nos, Frequency Meter - 1 Nos, Mini Scope Meter - 1 Nos, Vibration Meter Sould Level Monitor - 1 Nos, Portable pH Calibrator - 2 Nos, Module Tester - 1 Nos, DC Regulated Power Source - 2 Nos, Auto Transformer - 1 Nos, Nickel Cadmium Cell - 1 Nos, Scanner - 1 Nos, Torximitor - 2 Nos, Laptop - 2 Nos, Portable mA Calibrator - 3 Nos, Table Mounted mA Calibrator - 2 Nos, Portable mV Calibrator - 2 Nos, Test RTD - 2 Nos, Frequency counter/Timer - 1 Nos.			
A.25.0	COMPUTER FURNITURES			
A.25.1	Unit Operator Desk (8 Section) Angular installation dimension 7960mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	1
A.25.2	Common Operator Desk (8 Section) Straight installation dimension 7600mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	2	0
A.25.3	Simulator Operator Desk (6 Section) Straight installation dimension 5700mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.25.4	Simulator Operator Desk (3 Section) Straight installation dimension 2850mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.25.5	VOID			
A.25.6	Common & other area Operator Desk (2 Section) Straight installation dimension 1900mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	7	0
A.25.7	Computer tables with Shelf for each Unit 1000mm(L)X1650MM(H)X950MM(D)	Set	31	31
A.25.8	Computer tables with Shelf for Common & Other areas 1000mm(L)X1650MM(H)X950MM(D)	Set	5	0
A.25.9	Computer tables with Shelf for common areas 1000mm(L)X1650MM(H)X950MM(D)	Set	35	0

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A.25.10	Computer tables with Shelf for MIS Clients 1000mm(L)X1650MM(H)X950MM(D)	Set	40	40
A.25.11	Computer tables without Shelf 1000mm(L)x750mm(H)x1050mm(D)	Set	8	2
A.25.12	PC Rack 1000mm(L)x1900mm(H)x900mm(D) including fixing of power sockets, MCBs, Ethernet Switches hardware, etc	Set	2	2
A.25.13	Printer Tables 735mmx900mmx600mm including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	13	13
A.25.14	Printer Tables 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	18	0
A.25.15	Printer Tables for Simulator 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	2	0
A.25.16	Printer Tables for MIS Clients 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	40	40
A.25.17	Printer Tables for MIS Servers 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	2	2
A.25.18	Computer Chair Medium back with cushioned arms	Set	105	55
A.25.19	Computer Chair Medium back with cushioned arms for MIS Clients	Set	40	40
A.25.20	Almira 1780mm x 839mm x 380mm with glass window	Set	1	1
A.25.21	Safety lock key pad 350mm x 250mm x 250mm weight 10 kg, safety rack 1830mm x 410mm x 457mm	Set	1	1
A.26.0	TERMINATION OF POWER CABLES			
A.26.1	Termination of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) from UPS to Battery	Nos	14	14
A.26.2	Termination of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) UPS to ACDB	Nos	26	26
A.26.3	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Nos	4	0
A.26.4	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Nos	2	0
A.26.5	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Nos	4	0

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A.26.6	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Nos	2	0
A.27.0	COMMISSIONING OF THE FOLLOWING			
A.27.1	Commissioning of Transducers- Removal and recalibration of Power, Voltage, Current, Frequency out put 4-20 mA	Nos	25	25
A.28.0	STRUCTURAL MATERIALS			
A.28.1	ISMC 100, ANGLE 50X50X6 & 2.5MM THICK Plates	MT	10.5	11.5
B	BHEL TRICHY SCOPE OF SUPPLY			
B.1.0	FUEL OIL SYSTEM			
B.1.1	PD Type Mass flow meter in HFO,LDO/HSD & HFO return line with mounting flanges, electronics amplifier box, inter connecting cabling, etc.	Set	3	3
B.1.2	Pressure Gauges	Nos	68	45
B.1.3	Temperature Indicator	Nos	16	6
B.1.4	Pressure Switches	Nos	22	22
B.1.5	Level Indicator	Nos	2	1
B.1.6	Temperature Elements	Nos	2	0
B.1.7	FSSS Local Oil Gun Maintenance Switch Box	Nos	18	18
B.1.8	H.E.A Exciter box 240 V AC alongwith retractor assembly 240 V AC solenoid, flexible spark rod 133 inch, spark top, flexible cable assembly 3 mtr long, SS hose 6.35mmx1000mmm, Air Filter Regulator 1/4 inch etc.	Set	16	16
B.1.9	Flame Scanner Head Assembly consisting fibre optic cable L130" lense barrel, flame processor module, Flame module, pigtail cable, pico fuse, card extender module, power supply module, 6 way JB, etc	Set	32	32
B.1.10	Microprocessor based flame scanner amplifier 8 Nos. of 19" racks of size 482x263x134 (WxDxH) to be mounted in flame scanner panel (CJF49/CJF50) supplied by EDN	Set	1	1
B.2.0	ACOUSTIC STEAM LEAK DETECTOR			
B.2.1	ASLD panel assembly and computer with monitor panel size 800mmx2315mmx800mm & App.Wt. 200 kg	Set	1	1
B.2.2	ASLD sensor assembly -30 Nos + Sonic Tube + Field Amplifier box with Module- 32 Set+ Power Supply Units-4 Nos+ JB- 1No, Calibrator-1 No, Sensor Pig tail cable-450 mtr	Set	1	1
B.3.0	FURNACE CCTV SYSTEM			
B.3.1	High Temperature Furnace Camera CCTV head assembly with advance retract mechanism and Local Control Unit panels (800mmx1000mmx300mm) with inter connecting pipes, air filter regulators, ss hose mounted at boiler 45 M elevation. Remote Control Box (600 mm x500 mmx 300 mm) with 24" monitor and accessories at CCR, 40" LED monitor & Multiplexer.	Set	2	2

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B.4.0	PNEUMATIC POWER CYLINDERS (REGULATING TYPE) Installation and Commissioning			
B.4.1	Pneumatic Power Cylinders with Position Transmitters controlled from SADC (App.Weight 20 kg each)	Set	132	132
B.4.2	Pneumatic Power Cylinders with SMART Positioners controlled from DDCMIS (App.Weight 20 kg each)	Set	16	16
B.4.3	PA/ID/FD Fans Blade Pitch Control Damper with SMART Positioner controlled from DDCMIS (App.Wt. 90 kg)	Set	6	6
B.4.4	Cold Air Regulating Dampers with SMART positioner alongwith linkage rod (App.Wt. 95 kg)	Set	8	8
B.4.5	Hot Air Regulating Dampers with SMART positioner alongwith linkage rod (App.Wt. 175 kg)	Set	8	8
B.4.6	Dynavane Filter Pressure Control Damper with SMART positioner	Set	1	1
B.5.0	GRAVIMETRIC FEEDER PANEL			
B.5.1	Gravimetric Feeder Remote Power Cabinet Size 1200x2315x600 and Wt.300 kg	Nos	8	8
B.5.2	Feeder Coal flow monitor assembly flange mounted	Nos	8	8
B.5.3	Feeder Electronics including 3 Nos. of Calibration probe with cable and 100 Nos. of Retro-Reflective Tape	Set	1	1
B.6.0	STEAM/WATER/PULVERIZER/AIR/FLUE GAS LINE INSTRUMENTS			
B.6.1	Pressure Indicators	Nos	15	15
B.6.2	DP Switches	Nos	1	1
B.6.3	Temperature Indicator	Nos	8	8
B.6.4	K-Type MTM Thermocouple 8MM OD & 8 M DUPLEX	Nos	8	8
B.6.5	K-Type MTM Thermocouple 8MM OD & 10 M DUPLEX	Nos	33	33
B.6.6	K-Type MTM Thermocouple 8MM OD & 12 M DUPLEX	Nos	38	38
B.6.7	K-Type MTM Thermocouple 8MM OD & 14 M DUPLEX	Nos	41	41
B.6.8	K-Type MTM Thermocouple 8MM OD & 16 M DUPLEX	Nos	37	37
B.6.9	K-Type MTM Thermocouple 8MM OD & 18 M DUPLEX	Nos	40	40
B.6.10	K-Type MTM Thermocouple 8MM OD & 20 M DUPLEX	Nos	63	63
B.6.11	K-Type MTM Thermocouple 8MM OD & 22 M DUPLEX	Nos	57	57
B.6.12	K-Type MTM Thermocouple 8MM OD & 24 M DUPLEX	Nos	47	47
B.6.13	K-Type MTM Thermocouple 8MM OD & 26 M DUPLEX	Nos	57	57
B.6.14	K-Type MTM Thermocouple 8MM OD & 28 M DUPLEX	Nos	16	16

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B.6.15	K-Type MTM Thermocouple 8MM OD & 30 M DUPLEX	Nos	12	12
B.6.16	DP Switches	Nos	2	2
B.6.17	Level Switches High/Low	Nos	20	20
B.6.18	DP Switches High/Low	Nos	17	17
B.6.19	ERV Controller with Pressure Switch App.Dimension(mm): 400x350x190; App.Wt: 10 kg	Set	4	4
B.7.0	LAYING AND TERMINATION OF CABLES (PVC,FRLS,ARMOURED CABLES FOR SCANNER, MILL FEEDER, AC CONTROLS AND INSTRUMENTATION)			
B.7.1	FLAME SCANNER CABLE-P/O SHIELED	Mtrs	8280	8280
B.7.2	2P X 0.5 SQMM O/A SHIELED INST.CABLE	Mtrs	1500	1500
B.7.3	4P X 0.5 SQMM O/A SHIELED INST.CABLE	Mtrs	4950	4950
B.7.4	8P X 0.5 SQMM O/A SHIELED INST.CABLE	Mtrs	32400	32400
B.7.5	12P X 0.5 SQMM O/A SHIELED INST.CABLE	Mtrs	5850	5850
B.7.6	2P X 1.5 SQMM P/O SHIELED INST.CABLE	Mtrs	9900	9900
B.7.7	2P X 0.5 SQMM P/O SHIELED INST.CABLE	Mtrs	3150	3150
B.7.8	4P X 0.5 SQMM P/O SHIELED INST.CABLE	Mtrs	8820	8820
B.7.9	8P X 0.5 SQMM P/O SHIELED INST.CABLE	Mtrs	7200	7200
B.7.10	12P X 0.5 SQMM P/O SHIELED INST.CABLE	Mtrs	4320	4320
B.7.11	3C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	500	500
B.7.12	5C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	500	500
B.7.13	7C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.14	9CX 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.15	12CX 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.16	12P X 1.31 SQ. MM. EXTN. CABLE - KX	Mtrs	2700	2700
B.7.17	2P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2700	2700
B.7.18	4P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2880	2880
B.7.19	8P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2000	2000
B.7.20	4P X 0.5 SQ.MM PTFE INST. CABLE - F	Mtrs	750	750
B.7.21	3C X 2.5 SQ.MM PTFE CONTROL CABLE	Mtrs	550	550
B.7.22	5C X 2.5 SQ.MM PTFE CONTROL CABLE	Mtrs	2000	2000
B.7.23	2P X 0.5 SQ.MM PTFE INST. CABLE - F	Mtrs	2600	2600
B.7.24	2P X 1.31 SQ.MM PTFE EXTENSION CABLE	Mtrs	3600	3600
B.8.0	CABLE TRAY			
B.8.1	CABLE TRAY-50 MM WIDTH	Mtrs	1750	1750
B.8.2	CABLE TRAY-100 MM WIDTH	Mtrs	5875	5875
B.8.3	CABLE TRAY-150 MM WIDTH	Mtrs	3750	3750
B.9.0	JUNCTION BOXES			
B.9.1	24 WAY FRP JUNCTION BOX WITH CANOPY	Nos	80	80
B.9.2	48 WAY FRP JUNCTION BOX WITH CANOPY	Nos	65	65
B.9.3	72 WAY FRP JUNCTION BOX WITH CANOPY	Nos	60	60
B.9.4	24 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	5	5
B.9.5	48 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	35	35
B.9.6	72 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	10	10
B.10.0	MISCELLENEOUS RACKS/PANELS			
B.10.1	Local Instrument Enclosures/Racks with Junction Boxes, App. Size: 1650x2150x800 (mm) and App.Wt: 500 kg	Set	15	15

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B.10.2	Pulveriser Dynamic Classifier - VFD Cabinet App. Size: 900x2100x700 (mm) and App.Wt: 100 kg	Nos	8	8
B.10.3	HWL-1&2 and MEF Controller JB App. Size: 600x600x250 (mm) and App.Wt: 50 kg	Nos	3	3
B.11.0	HARDWARES FOR TUBING			
B.11.1	1/4" Air Filter Regulators (for mill system)	Nos	8	8
B.11.2	1" Air Filter Regulators (for SADC System)	Nos	8	8
B.11.3	Purge Meter cum DP Regulator	Nos	16	16
B.11.4	1" OD SS TUBE	Mtrs	40	40
B.11.5	1/4" OD SS TUBE	Mtrs	4800	4800
B.11.6	3/4" OD SS TUBE	Mtrs	20	20
B.11.7	3/8" OD SS TUBE	Mtrs	55	55
B.11.8	1/4" TEFLON HOSE- 2 METER PER PIECE	Nos	135	135
B.11.9	1" TEFLON HOSE- 3 METER PER PIECE	Nos	5	5
B.11.10	1/2" TEFLON HOSE- 1 METER PER PIECE	Nos	18	18
B.12.0	MISCELLANEOUS ITEMS			
B.12.1	Structural Steel for fabrication of Supports consisting of angles, channels (ISA ISMC 100x50x6 wt 1250 kg, ISA 50x50x6 Wt. 800 kg,etc)	MT	2	2
B.12.2	1/2" GI Pipe	Mtrs	1215	1215
B.13.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
B.13.1	Heavy Duty Limit Switches for Burner Tilt Shear Pin Failure Indication Purpose	Nos	32	32
B.13.2	HWL 1 & 2 & MEFCV Motor Starter Panel	Set	1	1
B.13.3	Motor Operated Valves (MOV) Actuators (On/Off) in Various Applications	Nos	78	78
B.13.4	Motor Operated Valves Actuators (MOV) (inching) in Various Applications	Nos	35	35
B.13.5	Electric Actuators for Various Dampers (Open/Close)	Nos	16	16
B.13.6	Pneumatic Actuators for Various Dampers(Open/Close)	Nos	17	17
B.13.7	Limit Switches (Cabling and Checking) for manually operated dampers	Nos	44	44
B.13.8	Solenoids (different ratings) of Pneumatic Valves of Various applications - tubing, Cabling & Commissioning	Nos	213	213
B.13.9	Burner Tilt Shear Pin failure indication junction box App.Dimension: 280(H)x600(L)x200(D): weight 12 kg each	Nos	16	16
B.13.10	Calibration/Commissioning of Gravimetric Feeder Comprising of Feeder C&I Equipment like motion monitor sensor, micro switches, etc. along with Feeder Integral Cabinet of App.Size 600x750x350 and Wt.75 kg , LT Motors, etc.	Set	8	8
B.14	SCR PACKAGE			
B.14.1	INSTRUMENTS			
B.14.1.1	Pressure Indicators	Nos	13	3
B.14.1.2	Level Switches H/HH	Nos	10	6

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B.14.1.3	Level Transmitters	Nos	10	6
B.14.1.4	Differential Pressure Transmitters	Nos	10	8
B.14.1.5	Pressure Transmitters	Nos	49	25
B.14.1.6	Temperature Elements	Nos	42	28
B.14.1.7	Temperature Indicator	Nos	5	3
B.14.1.8	Ammonia Leak Detector	Nos	9	4
B.14.1.9	Density Analyzer	Nos	2	2
B.14.1.10	pH Analyzer	Nos	1	1
B.14.1.11	Oxygen Analyzer: Consisting of insitu, flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	4	4
B.14.1.12	NoX Analyzer: Consisting of insitu, flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	6	6
B.14.1.13	SoX Analyzer: Consisting of insitu, flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	4	4
B.14.1.14	NH3 Analyzer: Consisting of insitu, flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	2	2
B.14.1.15	Flow Elements	Nos	14	14
B.14.1.16	Flow Transmitters	Nos	20	20
B.14.2	CABLES			
B.14.2.1	4P X 0.5 SQ.MM. O/A SHIELDED INST. CABLE	Mtrs	7200	7200
B.14.2.2	8P X 0.5 SQ.MM. O/A SHIELDED INST. CABLE	Mtrs	5400	5400
B.14.2.3	12P X 0.5 SQ.MM O/A SHIELDED INST. CABLE	Mtrs	900	900
B.14.2.4	2P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	2200	2200
B.14.2.5	4P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	7200	7200
B.14.2.6	8P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	5760	5760
B.14.2.7	3C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	2430	2430
B.14.2.8	5C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	8100	8100
B.14.2.9	9C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	1500	1500
B.14.2.10	12C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	5400	5400

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B.14.2.11	2P X 1.31 MM ² EXTENSION CABLE - KX	Mtrs	100	100
B.14.2.12	4P X 1.31 MM ² EXTENSION CABLE - KX	Mtrs	800	800
B.14.3	JUNCTION BOXES			
B.14.3.1	24 WAY JUNCTION BOX	Nos	12	12
B.14.3.2	48 WAY JUNCTION BOX	Nos	17	17
B.14.3.3	24 WAY JUNCTION BOX-FLAME PROOF	Nos	10	10
B.14.3.4	48 WAY JUNCTION BOX-FLAME PROOF	Nos	10	10
B.14.3.5	72 WAY JUNCTION BOX-FLAME PROOF	Nos	6	6
B.14.4	PUSHBUTTON STATIONS			
B.14.4.1	E-STOP PUSH BUTTON STATION	Nos	10	10
B.14.4.2	FOGGING PUSH BUTTON STATION	Nos	5	5
B.14.5	CABLE TRAYS			
B.14.5.1	Cable Trays - 50mm Perforated with accessories	Mtrs	250	250
B.14.5.2	Cable Trays - 100mm Perforated with accessories	Mtrs	125	125
B.14.6	MISCELLANEOUS RACKS/PANELS			
B.14.6.1	Local Instrument Enclosures/Racks with Junction Boxes, App. Size: 1650x2150x800 (mm) and App.Wt: 1000 kg	Set	7	7
B.14.7	SUPPORTING MATERIALS			
B.14.7.1	ANGLE (50X50X6)/CHANNEL(100X50)	MT	3	3
B.14.8	EARTHING MATERIALS			
B.14.8.1	Earth Flat (50x6)	Mtrs	125	125
B.14.8.2	Earth Wire 1.219 mm GI	Mtrs	350	350
B.14.9	IMPULSE TUBE OD 6.35X1.6X9500-SA213TP304H with accessories	Mtrs	320	320
B.14.10	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
B.14.10.1	Motor Operated Valve (MOV) Actuators (On/Off) in various locations	Nos	12	8
B.14.10.2	Motor Operated Valves Actuators (MOV) (Regulating) in Various Locations	Nos	3	1
B.14.10.3	Unit Directional Drives	Nos	19	19
B.14.10.4	Pneumatic Operated On/Off/Control Valves with accessories	Set	44	11
C	BHEL-PIPING CENTRE SCOPE OF SUPPLY			
C.1.0	Local Instruments			
C.1.1	Pressure Gauges	Nos	40	40
C.1.2	Temperature Gauges	Nos	104	104
C.1.3	Thermowells (Screwed and Welded)	Nos	197	197
C.1.4	Level Gauges	Nos	7	5
C.1.5	Sight Flow Glasses	Nos	56	56
c.1.6	Averaging Pitot Tube	Set	3	3
C.2.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
C.2.1	Control Valves - for LP Start Up Systems & SCAPH Sysyems - including Air Filter Regulators, Positioners, Testing upto DCS	Set	5	5
C.2.2	MOV Actuators for SCAPH, CW Aux Steam,etc	Nos	16	16

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C.2.3	LT Drives: Condensate Drain Pumps, Emergency Fill Pumps	Nos	5	5
D	BHEL RANIPET SCOPE OF SUPPLY			
D.1	OPACITY MONITOR (Installation and Commissioning)			
D.1.1	Opacity Monitoring System consisting of Sender/Receiver/Ref/Control Unit 1 No. each, 5 Metre Slave wire cable-1 No., Purge Air Blower with filter-1 No., Power JB-1 No., Weather Hood Cover for Purge Air Blower JB-1 No. Fully auto. Electric Operated Fail Safe Shutter-2 Nos., Differential Pressure Switch-2 Nos., Mounting Flange With Pipe - 2 Nos., Weather Hood Cover for Sender/Receiver Units - 2 Nos., Weather Hood Cover for Power JB-2 Nos. & Purge Air Hose	Set	4	4
D.2.0	AUTOMATIC LEAKAGE CONTROL SYSTEM-Air Pre Heater			
D.2.1	ALCS DCS panel 750x750x2067 mm. App. Wt.90 kg	Nos	1	1
D.2.2	ALCS Drive Control Panel 680x400x1053 mm App.Wt.50 kg	Nos	6	6
D.2.3	ALCS Controller with panel 370x210x520 mm App. Wt. 5 kg	Nos	6	6
D.2.4	Sensor Electronic with Enclosure 140x100x70 mm	Nos	6	6
D.2.5	Interfacing Box 140x100x70 mm App.Wt.5 kg.	Nos	6	6
D.2.6	Shielded Teflon Cable for ALCS	Mtrs	30	30
D.3.0	Instruments of APH/Fans/Gates & Dampers			
D.3.1	Pressure Switches	Nos	4	4
D.3.2	Pressure Indicators	Nos	24	24
D.3.3	RTD With Thermowell	Nos	8	8
D.3.4	Temperature Indicator	Nos	10	10
D.3.5	Flow Indicating Switch	Nos	4	4
D.3.6	Go Switch	Nos	2	2
D.3.7	Dial Thermometer	Nos	2	2
D.3.8	Temperature Elements	Nos	12	12
D.3.9	Thermocouple with Thermowell	Nos	56	56
D.3.10	On/Off Switch Box including light assembly and interconnecting heat resistant cable	Set	2	2
D.3.11	Temperature Indicators-Fans	Nos	24	24
D.3.12	RTDs with Thermowell-Fans	Nos	64	64
D.3.13	Pressure Gauges-Fans	Nos	2	2
D.3.14	Pressure Transmitters-Fans	Nos	2	2
D.3.15	Angular Position Transmitters-For FD/ID/PA Fans	Nos	6	6
D.3.16	Pressure Switches-GAD	Nos	10	10
D.4.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
D.4.1	Electric Actuators for Various Dampers (Open/Close)	Nos	76	76
D.4.2	Pneumatic Actuators for Various Dampers (Open/Close)	Nos	27	27
D.4.3	Solenoid Valves for APH	Nos	2	2
D.4.4	Lub Oil Skids for Air Preheater: The scope of work includes removal of instruments, calibration, refixing,	Set	4	4

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	checking cable connection from JB to instruments etc. The app. Quantity of instruments for each skids given below: Pressure Gauges-2 Nos. Temperature Gauges-2 Nos., Flow Switches-2 Nos.			
D.4.5	Fan Motor Bearing Temperature Indicators for all fans (Removal, Calibration and refixing only)	Nos	24	24
D.4.6	Fan Motor Bearing/Winding RTDs (Checking of healthiness only)	Nos	64	64
D.4.7	Lub Oil Skids for FD Fans: The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantityof instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Sensing Elements: -3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-01 No., Pr. Gauge-3 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 02 No.	Set	2	2
D.4.8	Lub Oil Skids for ID Fans: The scope of work includes removal of instruments for calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantityof instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Elements - 3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-1No.,Pr. Gauge-6 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 05 Nos.	Set	2	2
D.4.9	Lub Oil Skids for PA Fans: The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantityof instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Elements- 3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-1 No., Pr. Gauge-6 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 05 Nos.	Set	2	2
E	BHEL-HYDERABAD SCOPE OF SUPPLY			
E.1.0	TG INSTRUMENTS			
E.1.1	Pressure Gauges	Nos	46	46
E.1.2	Differential Pressure Gauges	Nos	4	4
E.1.3	Pressure Transmitters	Nos	46	46
E.1.4	Pressure Switches	Nos	3	3
E.1.5	RTDs with Thermowell	Nos	18	18
E.1.6	Chromel alumel Type Thermocouple	Nos	15	15
E.1.7	Level Gauges (Reflex Type)	Nos	1	1
E.1.8	Level Transmitters (Guide Wave Radar Type, top mounted)	Nos	2	2

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E.1.9	Speed Measuring Loop with probe	Nos	3	3
E.1.10	Proximeter Units, Local Field Cable etc. for Governing Sytem	Set	18	18
E.1.11	E/P Transducers	Nos	4	4
E.2.0	DRIP PUMP/CWP/TDBFP/CEP INSTRUMENTS			
E.2.1	Temperature Gauge	Nos	2	2
E.2.2	Pressuer Gauges	Nos	10	10
E.2.3	Pressure Switch	Nos	5	5
E.2.4	Flow Transmitters	Nos	5	5
E.2.5	Reverse Rotation Indicators	Nos	2	2
E.2.6	Flow Glass Indicators	Nos	5	5
E.2.7	Level Glass Indicators	Nos	5	5
E.2.8	Temperature Elements (RTDs)	Nos	81	81
E.2.9	Thermowells	Nos	6	6
E.3.0	HEAT EXCHANGERS (LP & HP Heaters) &DEAERATORS			
E.3.1	Pressure Gauges	Nos	12	12
E.3.2	Level Gauges	Nos	14	14
E.3.3	Level Switches	Nos	3	3
E.3.4	Thermowell	Nos	8	8
E.3.5	Bimetallic Temperature Gauges	Nos	6	6
E.4.0	PANEL/FIELD MOUNTED INSTRUMENTS			
E.4.1	TSI System for BFP Drive Turbine and gear box consisting of the following: Configuration of Laptop with software-1 No., Monitor Rack with Modules (to be mounted on CWW panel) app. Wt. 40 kg per rack-1 Set, relative shaft vibration sensor probes 8mm reverse mounted Turbine and gear box-8 Nos, Axial Displacement Probes-3 Nos., Eccentricity Probe-1 No., Zero Speed Probe - 1 No., Key phasor-1 No., Bearing housing vibration Probes-4 Nos., Differential Expn. Probe -1 No., Casing Expansion-1 No., with probe extension cables-18 Nos., Probe drivers for VIBR-17 Nos., Driver Housing -12 No., JB - 3 Nos., Flexible conduits-150 Mtr., Cable seal, Cable connectors, Mounting brackets for vibration/differential exp/brg housings, RS485 cable with connector for DCS 35 Mtr long etc and calibration kit.	Set	2	2
E.4.2	Fabrication of Local Instrument Racks, each of size 1500x1700mm with the following materials Channel (100x50mm), Angle (50x50x6mm), 4mm Thick Sheet (400x120mm) and 10mm Thick Plate (375x770mm).	MT	2	2
E.4.3	Temperature Indicators of BFP, CEP (Removal, Calibration & Refixing only)	Nos	8	8
E.4.4	Erection and Commissioning of Oil Purification Control Panel of Size 550 (W)x250(D)x1315(H) of App. Wt. 100 kg	Nos	1	1
E.5.0	LOCAL GAUGE BOARD (LGB) / LOCAL I NSTRUMENT RACK (LIR) (including removal, calibration and re-fix ing of LGB mounted instruments)/JB			

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E.5.1	LGB (LGB -1)Assembly for Feed Water Service for TDBFP/MD BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs. Approximate Size 1100 x900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Pressure Gauge: 4 Nos.DP Gauges: 2 Nos.Temperature Gauges: 2 Nos.	Set	3	3
E.5.2	LGB (LGB-2) Assembly for SW & Cooling Water Service of TD/MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs. Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Temperature Gauges: 8 Nos. Pressure Gauge - 1 Nos. DP Gauges - 3	Set	3	3
E.5.3	LGB (LGB-2) Assembly for Lub oil service of TD / MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs.Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Temperature Gauges: 4 Nos. Pressure Gauge - 4 Nos.	Set	3	3
E.5.4	LGB (LGB-1) Assembly for 3 Nos. CEP instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs.Quantity of instruments per set is Pressure Gauges: 6 Nos..Diff. pressure Gauges: 3 Nos.temp. gauge qty 3 nos Approximate Size 1100 x 900 x 2200 mm; Weight = 600 kg each	Set	1	1
E.5.5	Local instrument rack (LIR) assembly for TDBFP/MD BFP Transmitters. This LIR includes PT & DPTs,tubing , fittings, JBs, Main-fold valves and wiring from JBs to transmitters. Approximate Size 2000 x 650 x 2150 mm; Weight = 350 kg. Quantity of instruments per set is DP transmitters: 05 Nos.Pressure transmitter : 05 Nos.	Set	3	3
E.5.6	Local Instrument Rack (LIR) assembly for CEP-A,B&C pumps to mount Pr. Transmitters. This LIR includes Transmitters, tubing, fittings, JBs, Manifolds Valves Approximate Size: 2000 x 600 x 2150 mm;and wiring from JBs to transmitters Weight = 300 kg Quantity of instruments per set is Pressure transmitters: 9 Nos, DP transmitters : qty 3 nos	Set	1	1
E.5.7	24 Terminals JB for Thrust Bearing RTDs	Nos	6	6
E.6.0	SUPPORT MATERIALS			
E.6.1	Structural steel (ISMC 100 x 50 mm qty 20 mtrs, Angle 45 x 45 x 5 mm-qty 24 mtrs etc.)	MT	0.5	0.5
E.6.2	Impulse Tube Dia 16X2.6 (CS) for BFP/CEPs	Mtrs	1900	1900
E.6.3	SS tube 12.7x2.1	Mtrs	750	750
E.6.4	SS tube 6x1.5	Mtrs	35	35

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E.7.0	Cables/Cable Trays for BFP/CEPs			
E.7.1	4 Pair x 0.5 sqmm cable	Mtrs	500	500
E.7.2	Perforated Cable Tray 50 mm Wide	Mtrs	80	80
E.7.3	Perforated Cable Tray 150 mm Wide	Mtrs	45	45
E.8.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
E.8.1	Mill Motor Temperature Indicators (Removal, Calibration & Fixing)	Nos	16	16
E.8.2	Mills Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Transmitter-03 Nos., Temperature Elements-09 Nos., Temp.Gauges-02 Nos., DP Transmitters- 01 No., DP Indicator-01 No., Pressure Gauge-3 Nos., Pressure Transmitters- 03 Nos. and Flow Transmitter-06 Nos.	Set	8	8
E.8.3	LT Drives of Lub Oil Skid of Mills	Nos	16	16
E.8.4	Turbine Lub Oil Purification Skid: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Switch-02 Nos., Temperature Elements-02 Nos., Temp.Gauges-03 Nos., DPI with Switch- 01 No., Pressure Gauge-04 Nos.	Set	2	2
E.8.5	LT Drives of Oil Purification Skid of Turbine	Nos	2	2
E.8.6	Control Valves with Smart Positioner, AFR, Limit Switches, inbuilt Position Transmitters, Junction Box,etc	Set	8	8
E.8.7	TDBFP Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Transmitter-02 Nos., Temperature Elements-09 Nos., Temp.Gauges-15 Nos., DP Transmitters- 02 No., DP Indicator-02 No., Pressure Gauge-17 Nos., Pressure Transmitters- 08 Nos. and Pressure Switch-02 Nos.	Set	2	2
E.8.8	LT Drives of TDBFP System	Nos	18	18
E.8.9	MOV Actuators for TDBFP System	Nos	26	26
E.8.10	MDBFP Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid and commissioning of the system. Equipment per Set: Level Transmitter-01 Nos., Temperature Elements-33 Nos., Temp.Gauges-18 Nos., DP Transmitters- 01 No., DP Indicator-01 No., Pressure Gauge-08 Nos. and Pressure Transmitters- 02 Nos.	Set	1	1
E.8.11	LT Drives of MDBFP System	Nos	9	9
E.8.12	Hydraulic Coupling of MDBFP: The scope of work covers a) Removal, calibration & re-fixing of following	Set	1	1

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	instruments. Pressure Indicators: 2 Nos. DP Indicator: 1 No. Temperature Indicators: 14 Nos. Pressure Transmitters: 6 Nos. Level transmitter: 1 No. DP transmitter: 1 No. RTDs (Checking only): 18 Nos. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. C) Commissioning of Speed Indicators etc.			
E.8.13	Governing Console Board: The scope includes removal, calibration and refixing of Instruments, wiring etc. Size of panel 1200 x 1650 x 450 mm The approximate quantity of instruments is Pressure Gauges: 10 Nos. Pressure Switches: 24 Nos.	Set	1	1
F	BHEL-BHPV VIZAG SCOPE OF SUPPLY			
F.1	Erection and Commissioning of the following Instrumentation items			
F.1.1	Flame Scanner Head Assembly, mounting flange accessories, flexible hoses, fibre optic cable, Lens Barrel Assembly, Miniature 6 way Junction box, etc	Set	1	0
F.1.2	Microprocessor based flame scanner amplifier 19" racks of size 482x263x134 (WxDxH) to be mounted in flame scanner panel supplied by BHEL-EDN	Set	1	0
F.1.3	H.E.A Exciter box alongwith retractor assembly, flexible spark rod, spark tip, flexible cable assembly, maintenance switch, SS hose, Air Filter Regulator, etc.,	Set	1	0
F.1.4	Pressure Gauges	Nos	28	0
F.1.5	Temperature Gauges	Nos	10	0
F.1.6	Reflex Type Level Gauges	Nos	4	0
F.1.7	Direct Water Level Gauges	Nos	2	0
F.1.8	24 Way Junction Boxes	Nos	3	0
F.1.9	48 Way Junction Boxes	Nos	1	0
F.1.10	Cable Tray 50 mm Width Perforated type	Mtrs	100	0
F.1.11	Cable Tray 150 mm Width Perforated type	Mtrs	100	0
F.1.12	Impulse Pipes and fittings 21.3x3.73-SA106Gr B	Mtrs	110	0
F.1.13	Structural Steel for fabrication of Supports consisting of angles, channels (ISA ISMC 100x50x6, ISA 50x50x6)	MT	1	0
F.1.14	Pneumatic actuator with feedback smart positioner and transmitter for FD Fan inlet damper with linkage rod	Set	2	0
F.2	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
F.2.1	Trip Valves, Control Valves along with Positioner, AFR etc. -LO PC, SB Drain, Feed Water CV, DM Water CV, Spray CV	Set	14	0
F.2.2	Furnace to WB DP Control Damper with feedback smart positioner and transmitter	Set	2	0
F.2.3	Sootblower/LO Trip valve with solenoids, AFR etc	Set	2	0
F.2.4	Electric Actuators for FD Fan outlet	Nos	2	0

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F.2.5	LT Drives (0.27 kW to 132 kW)	Nos	13	0
F.2.6	MOV Actuators	Nos	16	0
G	BHEL-HARIDWAR SCOPE OF SUPPLY			
G.1.0	GENERATOR AUXILIARY CONTROL CABINETS-INSTALLATION AND COMMISSIONING			
G.1.1	Moisture Measurement System for Generator, including indicator cum controller placed in control room 144 x 72 and sampling system in field 760 x 600 x 210 . Weight : 100 Kg	Set	2	2
G.1.2	Gen end vibration monitoring cabinet (CXW01E) dimension 800mm(W) x 600mm (D) x 2200mm (H) Including preamplifier units, special cables interconnecting, PC based monitor and printer computer table etc.aprox weight 150 kg	Set	1	1
G.1.3	Grounding Brush Monitor (Wall mounted) Approx. size & weight : 235 x 235 x 285 mm; 100 Kg.	Set	1	1
G.2.0	INSTALLATION AND COMMISSIONING OF GENERATOR INSTRUMENTS:			
G.2.1	Pressure Gauges	Nos	33	33
G.2.2	Temperature Gauges	Nos	15	15
G.2.3	Pressure Transmitters	Nos	29	29
G.2.4	Differential Pressure Transmitters	Nos	1	1
G.2.5	Differential Pressure Indicators	Nos	2	2
G.2.6	Differential Pressure Switch	Nos	6	6
G.2.7	Flow Meters	Nos	8	8
G.2.8	Flow Switches	Nos	2	2
G.2.9	Level Indicator	Nos	1	1
G.2.10	Level Transmitter	Nos	1	1
G.2.11	Position Transmitters	Nos	2	2
G.2.12	Level Switches (capacitance type)	Nos	19	19
G.2.13	RTDs	Nos	165	165
G.2.14	Pressure Switches	Nos	2	2
G.2.15	Thermocouples (NiCrNi) (Generator Bearing Temp: 4 Nos.& Exciter Bearing Temp: 2 Nos.)	Nos	18	18
G.2.16	Conductivity Sensor with Transmitter	Nos	4	4
G.2.17	Limit Switches	Nos	8	8
G.3.0	REMOVAL, CALIBRATION & REFIXING OF GENERATOR INSTRUMENTS			
G.3.1	Pressure Gauges	Nos	13	13
G.3.2	DP Gauges	Nos	2	2
G.3.3	Temperature Gauges	Nos	8	8
G.3.4	Pressure Transmitter	Nos	5	5
G.3.5	DP Transmitter	Nos	5	5
G.3.6	Pressure Switches	Nos	8	8
G.3.7	Level Switches	Nos	6	6
G.3.8	Flow Meters	Nos	8	8
G.3.9	Conductivity Cells	Nos	3	3
G.3.10	PW Conductivity Indicator	Nos	1	1
G.3.11	Checking the healthiness of the RTDs/Thermocouples	Nos	180	180
G.4.0	LAYING AND TERMINATION OF POWER CABLES FOR 24 V SOLENOIDS			

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G.4.1	4Cx2.5 Sqmm	Mtrs	12960	12960
G.5.0	LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON GENERATOR PIPINGS			
G.5.1	Vacuum Switches	Nos	2	2
G.5.2	Pressure Gauges	Nos	7	7
G.5.3	Pressure Switches	Nos	1	1
G.5.4	PT RTD, Duplex Type	Nos	2	2
G.5.5	Dial Thermometer	Nos	5	5
G.6.0	LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON H2 COOLER PIPINGS			
G.6.1	Pressure Gauges	Nos	8	8
G.6.2	Pressure Switches	Nos	1	1
G.6.3	PT RTD, Duplex Type	Nos	17	17
G.6.4	Moisture Sensor Probe	Nos	2	2
G.6.5	Dial Thermometer	Nos	6	6
G.7.0	LOOSE ITEMS TO BE INSTALLED AND COMMISSIONED ON UCB			
G.7.1	Analog/Digital Indicators	Nos	10	10
G.7.2	Bar Graph Indicators	Nos	5	5
G.7.3	Pressure Indicators (Moving Coil Type)	Nos	2	2
G.7.4	Temperature Indicator (Moving Coil Type)	Nos	2	2
G.7.5	Vibration Indicator along with Selector Switch	Nos	4	4
G.8.0	TURBINE INSTRUMENTATION GAUGES AND SENSORS			
G.8.1	RTDs	Nos	13	13
G.8.2	Thermocouples (for MAV,LBA,LBB,LBG,PGB,MAW,MAA,MAB,MAN etc	Nos	138	138
G.8.3	Thermocouples routed alongwith innercasing as per drawing only installation and healthiness checking for TSE, IPC exhaust, LPC outer, LPC-2 outer etc	Nos	9	9
G.8.4	Temperature Gauges	Nos	19	19
G.8.5	Pressure Transmitters / Absolute Pressure Transmitters	Nos	70	70
G.8.6	Differential Pressure Transmitter	Nos	6	6
G.8.7	Pressure Switches	Nos	13	13
G.8.8	Temperature Switch (Main oil Tank)	Nos	2	2
G.8.9	Differenital Pressure Switches	Nos	6	6
G.8.10	Pressure Gauges	Nos	47	47
G.8.11	Level Transmitters with amplifire, bar probe	Nos	6	6
G.8.12	Level Switches	Nos	18	18
G.8.13	Limit Switches	Nos	11	11
G.8.14	Positon Transmitters	Nos	36	36
G.8.15	Speed Sensors	Nos	9	9
G.8.16	Level Indicator	Nos	6	6
G.8.17	Emergency Push Button at CCR, Turbine Hall, LPBP	Nos	12	12
G.9.0	PRESSURE INSTRUMENTS RACKS			
G.9.1	Instrument rack TYPE A 2150mm(W) x 700mm(D) x 2150mm(H)	Set	6	6
G.9.2	Instrument rack TYPE B 1250mm(W) x 700mm(D) x 880mm(H)	Set	4	4

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G.10.0	IMPULSE PIPES - TURBINE			
G.10.1	SEAMLESS C.S.TUBE 21.3X2.3 ST-BQ-A1-CDS-TUBE	Mtrs	200	200
G.10.2	CARBON STEEL TUBE 88.9x4 ST-B-HFSPIPES (RACK OF COND.INST.)	Mtrs	80	80
G.10.3	SEAMLESS C.S. TUBE 21.3X2.3 ST-BQ-A1-CDS-TUBE (RACK OF EXT & GLAND SEAL INS)	Mtrs	150	150
G.10.4	SEAMLESS C.S.TUBE 21.3x2.3 ST-BQ-A1-CDS-TUBE (RACK OF WATER INJECTION INST.)	Mtrs	120	120
G.10.5	SEAMLESS A.S. TUBE D=13.5X2.6 ST-2.25 CR-1MO-TUBE (TEMP. & PR. CONNECTION)	Mtrs	17	17
G.10.6	S.L TUBES (GR.T22)21.3X2.77 ST-2.25 CR-1MO-TUBE (RACK OF EXT & GLAND SEAL INS)	Mtrs	52	52
G.10.7	GR:T91 (13.5X2.6) HTS -ALY- ST-TUBE (TEMP. &PR. CONNECTION)	Mtrs	10	10
G.10.8	SEAMLESS TUBE GR.T91 21.3x7.47 HTS -ALY-ST-TUBE (RACK OF MS PR.INSTRUMENTS)	Mtrs	303	303
G.10.9	SEAMLESS A.S. TUBE 21.3X2.77 HTS -ALY- ST-TUBE (RACK OF HRH/MS PR.INSTRUMENTS)	Mtrs	173	173
G.11.0	JUNCTION BOXES-TO BE INSTALLED AND COMMISSIONED			
G.11.1	Junction Box (to be mounted as per hardwar drg)	Nos	16	16
G.11.2	JB for thermocouple HPT, IPT, LPT1&2, TSE, IPC exhaust, LPC outer etc	Nos	12	12
G.11.3	Push button for TG and lube oil room	Nos	12	12
G.11.4	STRUCTURAL STEEL (for both turbine and generator instruments) 50x50x6 angle	MT	1	1
G.12.0	INSTRUMENTS FOR HEAT EXCHANGERS (CONDENSER, GSC, LP HEATER-1, TOC, CFC)-TO BE COMMISSIONED			
G.12.1	Level Switches (Float type)	Nos	12	12
G.12.2	Temperature Gauges	Nos	16	16
G.12.3	Pressure Gauges	Nos	4	4
G.12.4	Level Gauges	Nos	8	8
G.12.5	MIS type Thermometer	Nos	12	12
G.12.6	Thermowell (125/175/325)	Nos	52	52
G.13.0	VOID			
G.14.0	VOID			
G.15.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
G.15.1	Condenser Vacuum Pump Removal, calibration and commissioning of CVP skid mounted instruments including CVP PLC and motor mounted on the skid. The approximate quantity of skid mounted instruments shall be Pressure Transmitters - 02 Nos., Pressure Indicators – 04 Nos., Temperature Transmitters - 03 Nos., Temperature Indicators - 04 Nos., Flow Indicator cum Switch – 01 No., Level Indicator-1 No., Rotameter-01 No., Level Switches – 02 Nos., DP Switch – 1 , Diff. Pr.Indicator-01 No., Junction Box-1	Set	2	2

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	No. & Temperature Element-02 Nos., Pneumatic Butterfly Valve-01 No.,			
G.15.2	LT drives for Vacuum pump, Recirculation pump,	Nos	4	4
G.15.3	Oil Centrifuge Unit - Removal, calibration and refixing of all instruments mounted on centrifugal unit, checking and commissioning of the system.	Set	2	2
G.15.4	NRV Valves, Stop Valves, Control Valves, HP/LP Bypass Valves with accessories	Set	40	40
G.15.5	Position Transmitters (Removal, calibration and re-fixing)	Nos	19	19
G.15.6	Limit Switch (checking only)	Nos	76	76
G.15.7	Solenoid Valves (checking only) (steam turbine ext.valves & condenser)	Nos	61	61
G.15.8	Motorized temperature control valve with accessories for cold gas	Set	1	1
G.15.9	Motorized temperature control valve with accessories for primary water	Set	1	1
G.15.10	Turbine speed monitor consisting of switch amplifier, measuring converter diode clamp Hydraulic Speed Control Equipment Rack (LR1)	Set	1	1
G.15.11	Governing System Control rack : Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below: Pressure Gauges : 9 Nos. Pressure Switches : 4 Nos.	Set	2	2
G.15.12	LP Bypass Control Rack/Skid : Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below Transmitters(Pressure, Temp &Level)-7 Nos. Switches(Pressure, DP& Flow)-6 Nos. Pressure gauges:5 Nos	Set	1	1
G.15.13	Supply Unit Racks for HP Valve-1, HP Valve-2, IP Valves (SU1, SU2 & SU3) Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. Total quantity of instruments for all 3 racks is as below: Pressure Gauges : 8 Nos. Pressure Switches: 5 Nos DP Switches : 2 Nos. Pressure transmitters :3 Limit switch:3	Set	1	1
G.15.14	Seal Oil Rack	Set	1	1
G.15.15	Stator Water Rack	Set	1	1
G.15.16	Seal Oil Level / PrTsr Instrument Rack	Set	1	1
G.15.17	Stator Water DP Instrument Rack	Set	1	1
G.15.18	H2 Dryer Unit	Set	1	1
G.16.0	LAYING AND TERMINATION OF INSTRUMENTATION CABLES			
G.16.1	Overall Shielded Cable			
G.16.1.1	2P x 0.5 sqmm	Mtrs	13500	13500

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G.16.1.2	4P x 0.5 sqmm	Mtrs	9450	9450
G.16.1.3	8P x 0.5 sqmm	Mtrs	3150	3150
G.16.1.4	12P x 0.5 sqmm	Mtrs	1350	1350
G.16.1.5	2P x 0.5 sqmm (Cu braided)	Mtrs	5850	5850
G.16.1.6	4P x 0.5 sqmm (Fire Survival)	Mtrs	3150	3150
G.16.2	Individual & Overall Shielded Cable			
G.16.2.1	4P x 0.5 sqmm	Mtrs	6300	6300
G.16.2.2	8P x 0.5 sqmm	Mtrs	11700	11700
H	BHEL-BHOPAL SCOPE OF SUPPLY			
H.1.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
H.1.1	PT 100 Simplex/Duplex - 3 Wire/4 Wire RTD Sensors for winding/bearings of MDBFP/Drip Pump/CEP/CWP/Mill/DMCW/ACW,etc Motors	Nos	901	757
H.1.2	Electric Actuators for various sizes of Valves	Nos	68	39
H.1.3	11 kV HT Drives ID/FD/PA/MDBFP - Each 2 Nos., CW Pump- 5 Nos	Nos	7	7
H.1.4	3.3 kV HT Drives DMCW(TG)/CEP/ACW - 3 Nos each., Mills-8 Nos, BCW-1 No., Drip Motor 2 Nos.	Nos	22	22
H.1.5	3.3 kV HT Drives of other applications (Stage wise)	Nos	17	0
I	VOID			
J	BHEL-PEM SCOPE OF SUPPLY			
J.1.0	Instruments			
J.1.1	Ultrasonic Flow Transmitter with Controller (Raw Water/Ash Water/CW & ACW)	Nos	9	0
J.2.0	Laying and Termination of I/O Shielded, Screened, Twisted Pair, Type F Armoured Instrumentation Cables			
J.2.1	4 Pair x 0.5 sqmm	Mtrs	59400	59400
J.2.2	8 Pair x 0.5 sqmm	Mtrs	40500	40500
J.2.3	12 Pair x 0.5 sqmm	Mtrs	8640	8640
J.2.4	20 Pair x 0.5 sqmm	Mtrs	8640	8640
J.3.0	Laying and Termination of Overall Shielded, Screened, Twisted Pair, Type G Armoured Instrumentation Cables			
J.3.1	2 Pair x 0.5 sqmm	Mtrs	50580	50580
J.3.2	4 Pair x 0.5 sqmm	Mtrs	40680	40680
J.3.3	8 Pair x 0.5 sqmm	Mtrs	102960	102960
J.3.4	12 Pair x 0.5 sqmm	Mtrs	20700	20700
J.4.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
J.4.1	Control Valves with Smart Positioner, AFR, Air Lock Valve etc., LO TCV, Gland Steam inlet and dump	Set	29	29
J.4.2	Electric Actuators for Butterfly Valves	Nos	2	2
J.4.3	Oxygen Dosing Skid for CPU/Dearator O/L - Approximate qty of instruments per skid is Pressure Gauges: 03 Nos., Mass flow controllers- 02 Nos., Pressure Safety Valve - 2 nos. Pressure Transmitter: 6 Nos., Solenoid Valves : 5 No. Junction boxes: 2 Nos, oxygen cylinders - 8 Nos + 11 loose cylinders	Set	2	2

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J.4.4	Ammonia Dosing Skid - Approximate qty of instruments per skid is Pressure Gauges: 08 Nos., Level Gauge- 04 Nos, Pressure Transmitter: 04 Nos, level Transmitter: 06 Nos Differential Pressure indicating Transmitter - 02 Nos & Solenoid Operated Gate Valves - 06 Nos.	Set	1	1
J.4.5	NaOH Dosing Skid - Approximate qty of instruments per skid is., Pressure Gauges-03 Nos., Level Gauge-01 Nos, Level Transmitters: 02 Nos. Pressure transmitter-02 Nos. & Solenoid Operated Gate Valves - 02 Nos.	Set	1	1
J.4.6	Hydrazine dosing system Approximate qty of instruments per skid is Pressure Gauges: 08 Nos., Level Gauge- 04 Nos, Pressure Transmitter: 04 Nos, level Transmitter: 06 Nos Differential Pressure Transmitter-02 Nos. & Solenoid Operated Gate Valves - 06 Nos.	Set	1	1
J.5.0	Citric Acid Cleaning for Boiler - Installation and Removal			
J.5.1	Temp. Gauges	Nos	2	2
J.5.2	Pressuer Gauges	Nos	2	2
J.5.3	Thermocouple Stem type and MTM	Nos	8	8
J.5.4	Junction Boxes	Nos	3	3

1.9.2.0 BOQ of PACKAGE-B

SL.NO.	DESCRIPTION	UOM	UNIT # 3	UNIT # 4
A	EDN SCOPE			
A.1.0	Shifting from Stores to UCR, placement & erection of SG Package- Valmet DNA Control Cabinets			
A.1.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CJP75&CJP76, CJP34&35	Nos	2	2
A.1.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CAF41&CAF42	Nos	1	0
A.1.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg.CJP06,07,08	Nos	1	1
A.1.4	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJP23/24-CAF20/21, CJP25/26- CAF22/23 & CJP27/28-CAF24/25 & CJP29/30-CAF26/27	Nos	4	4
A.1.5	Suit of five Cubicles Size: 3750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 2000 kg. CJP01,02,03,04,05 & CJP58,59,60,61,62	Nos	2	2
A.1.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of SG Package- Valmet DNA Control Cabinets			

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A.1.1.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CJF75&CJF76, CJF34&35	Nos	2	2
A.1.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CAF41&CAF42	Nos	1	0
A.1.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJF06,07,08	Nos	1	1
A.1.4.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJF23/24-CAF20/21, CJF25/26- CAF22/23 & CJF27/28-CAF24/25 & CJF29/30-CAF26/27	Nos	4	4
A.1.5.1	Suit of five Cubicles Size: 3750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 2000 kg. CJF01,02,03,04,05 & CJF58,59,60,61,62	Nos	2	2
A.2.0	Shifting from Stores to UCR, placement & erection of TG Package- (Non-Core) Valmet DNA control cabinets			
A.2.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CJJ08, CJJ41 & CWW01	Nos	3	3
A.2.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CCA10 & CCA11	Nos	1	1
A.2.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJJ03,CJJ04 & CJJ53	Nos	1	1
A.2.4	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJJ01,02,05,06, CCA01,02,03,04, CJJ20,21,22,23 & CJJ30,31,32,33	Nos	4	4
A.2.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of TG Package- (Non-Core) Valmet DNA control cabinets			
A.2.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CJJ08, CJJ41 & CWW01	Nos	3	3
A.2.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CCA10 & CCA11	Nos	1	1
A.2.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CJJ03,CJJ04 & CJJ53	Nos	1	1
A.2.4.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CJJ01,02,05,06, CCA01,02,03,04, CJJ20,21,22,23 & CJJ30,31,32,33	Nos	4	4
A.3.0	Shifting from Stores to UCR, placement & erection of STN C&I Valmet DNA Control Cabinets			

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A.3.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CRE61/CTE01/CTE02/CTE03	Nos	4	4
A.3.2	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE04	Nos	1	0
A.3.3	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE51/52, CRE81/82, CRE53/54, CRE83/84, CRE55/56, CRE57/58, CRE59/60	Nos	7	7
A.3.4	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE77/78	Nos	1	0
A.3.5	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRE41/42/43, CRE48/49/50, CRE62/63/64, CRE65/66/67, CRE68/69/70	Nos	5	5
A.3.6	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRW01-03, 04-06, 11-13, 71-73, 74-76	Nos	5	0
A.3.7	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRE 01-04,05-08, 09-12,13-16,17-20,21-24,25-28,29-32,33-36,37-40,44-47	Nos	11	11
A.3.8	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRW07-10	Nos	1	0
A.3.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of STN C&I Valmet DNA Control Cabinets			
A.3.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CRE61/CTE01/CTE02/CTE03	Nos	4	4
A.3.2.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE04	Nos	1	0
A.3.3.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE51/52, CRE81/82, CRE53/54, CRE83/84, CRE55/56, CRE57/58, CRE59/60	Nos	7	7
A.3.4.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRE77/78	Nos	1	0
A.3.5.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRE41/42/43, CRE48/49/50, CRE62/63/64, CRE65/66/67, CRE68/69/70	Nos	5	5
A.3.6.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRW01-03, 04-06, 11-13, 71-73, 74-76	Nos	5	0
A.3.7.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRE 01-04,05-08, 09-12,13-16,17-20,21-24,25-28,29-32,33-36,37-40,44-47	Nos	11	11

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A.3.8.1	Suit of four Cubicles Size: 3000 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1600 kg. CRW07-10	Nos	1	0
A.4.0	Shifting from Stores to UCR, placement & erection of CPU C&I Valmet DNA Control Cabinets			
A.4.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE11, CTE12, CTE13, CTE14 & CTE16	Nos	5	0
A.4.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRA10/11	Nos	1	0
A.4.3	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRA01-03, 04-06, 07-09, 12-14	Nos	4	0
A.4.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of CPU C&I Valmet DNA Control Cabinets			
A.4.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CTE11, CTE12, CTE13, CTE14 & CTE16	Nos	5	0
A.4.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CRA10/11	Nos	1	0
A.4.3.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CRA01-03, 04-06, 07-09, 12-14	Nos	4	0
A.5.0	Shifting from Stores to UCR, placement & erection of SCR C&I Valmet DNA Control Cabinets			
A.5.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB01-03 & 04-06	Nos	2	2
A.5.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of SCR C&I Valmet DNA Control Cabinets			
A.5.1.1	Suit of three Cubicles Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg. CBB01-03 & 04-06	Nos	2	2
A.6.0	Shifting from Stores to UCR, placement & erection of T&AVT/EIS Control Cabinets & Network Panels/Network Enclosures			
A.6.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CFA01	Nos	1	0
A.6.2	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CXA01-02 & 03-04	Nos	2	0
A.6.3	EIS Control Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CYJ01	Nos	1	1
A.6.0.1	Alignment, Electrical Interconnection, Testing and Commissioning of T&AVT/EIS Control Cabinets & Network Panels/Network Enclosures			
A.6.1.1	Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CFA01	Nos	1	0
A.6.2.1	Suit of two Cubicles Size: 1500 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 800 kg. CXA01-02 & 03-04	Nos	2	0

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A.6.3.1	EIS Control Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CYJ01	Nos	1	1
A.6.0.2	Erection and Commissioning of Network Panels and Network Enclosures.			
A.6.0.2.1	Network Panel of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP11/21/41	Nos	3	3
A.6.0.2.2	Network Panel (LAN-I/II) of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP51/52	Nos	1	0
A.6.0.2.3	Network Panel (Common System) of Single Cubicle Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg. CNP31/32/33/35/36/37	Nos	3	0
A.6.0.2.4	Network Enclosures for LAN & BOP Systems of Size: 600 mm(W) X 500 mm(D) x 600 mm(H); Approx. weight 20 kg.	Nos	6	0
A.7.0	TURBINE SUPERVISORY SYSTEM FOR MAIN TURBINE			
A.7.1	Meggitt VM600 system with 19" Rack Control Cabinet- 2 Nos. (with power supply unit, back panel, CPU module, I/O cards, relay cards, protection cards), TFT monitors, server, A3 Colour printer, Ethernet to FO convertor, interconnecting cables, etc. Approx. Size and Weight of the Panel 750 x 800 x 2117 mm; 400 kg.	Set	1	1
A.7.2	Total loose supplied items to be mounted in the cabinet is as follows: Absolute Bearing Vibration sensors with isolators qty: 16; Relative Shaft Vibration sensors with isolators qty: 16; Absolute shaft expansion (HP & LP Rotor) with isolators qty: 4 each; Axial shaft/shaft position with isolators qty: 3; Reference phase measurement sensors with isolators qty: 1 No and Junction boxes qty: 12 Nos.	Set	1	1
A.8.0	HART MANAGEMENT SYSTEM (SUPERVISION OF E&C BY OEM)			
A.8.1	Hart Management System (HMS) Comprising of the following: HART Panel- 02 Nos., Workstation PC with 24" TFT Monitor-02 Nos., Colour laser Printer 01 No., and other loose supplied items like Hart / back plane communication modules, Patch cards/ 20 way FRC intra panel cables 69 set, RS485/RS232 Convertor, interconnecting Cables, etc. Approx. Size and Weight of the Panel 800(L) x 800(W) x 2415(H) mm; 400 Kg each.	Set	1	1
A.9.0	INSTRUMENTS			
A.9.1	Pressure Transmitter	Nos	265	195
A.9.2	Differential Pressure Transmitter	Nos	141	128
A.9.3	Ultrasonic type level transmitter	Nos	48	27
A.9.4	Flow Transmitter (DP type)	Nos	128	121
A.9.5	Guided Wave Radar Type Level Transmitter	Nos	24	24
A.9.6	Temperature Elements	Nos	330	330

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A.9.7	Pressure Gauge	Nos	151	151
A.9.8	Differential Pressure Gauge	Nos	20	20
A.9.9	Pressure and Differential Pressure switches	Nos	60	60
A.9.10	Temperature Gauge	Nos	130	130
A.9.11	Level Gauge	Set	1	1
A.9.12	Level Switch- Conductivity Type for CRH drain pots consists of two nos of level probes, field mounted electronic control units-1 No., interconnecting cables 10 mtr	Nos	4	4
A.9.13	Coal Bunker Level Monitoring System - 3D Scanner on Bunker top, 2 Nos. Panel at Bunker Floor/Unit, 1 No. Computer in CER/Unit.	Set	8	8
A.9.14	I/P Coverters for Burner Tilt & SADC	Nos	33	33
A.10.0	FLUE GAS ANALYZERS			
A.10.1	High temperature Oxygen Analyzer (in situ type) make: SECO; Consisting of insitu,flange mounted zirconium oxide type probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	2	2
A.10.2	Low temperature Oxygen Analyzer (in situ type) make: AICPL; Consisting of insitu,flange mounted zirconium oxide type probe and electronics-1 cabinet, Auto Calibration unit for three calibration cylinders, Zero span and one span cylinders along with accessories, 2/1 metre probe protectors and wall mounted panel for Analyzer. App.weight of analyser is 22 Kg	Set	9	9
A.10.3	CO Analyzer (In-Situ type) Consisting of CO Sensor head , High Temperature Probe (1800 mm app.), Protection tube (1800 mm app.), Temperature/Pressure Transmitters, Digital Display Unit, Air Dryer panel (App. size 760x760x210 mm), Power Supply Unit, Calibration Gas Cylinder filled with CO & Nitrogen, Pressure Switch for purge air blower, Air compressor-1 No. & connecting cables. App. weight of analyser is 22 kg.	Set	6	6
A.10.4	HF analyser Consists of Process & Purge tubes (1500 mm app.)-02 Nos, Transmitter/Receiver units-02 Nos, HF Gas Analyser Unit-01 No., Analyser Panel (App.Size 600x600x2000 mm)-01 No. (Wt. 200 kg), Air Purification unit-01 No., Power Supply unit-01 No., Canopies for Transmitter/Receiver/Power Supply unit (as applicable), Purge air unit-01 No., fail safe shutter with 10 mtr cable, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature	Set	1	1

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	transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.			
A.10.5	Opacity Analyser (In Situ type) Consisting of Transceiver unit -02 No each with air purge connections, Signal processor unit, power supply unit, display control unit, fail safe shutter with 10 mtr cable against power or purge air failure, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.	Set	1	1
A.10.6	SOX/NOX/CO (Combined) analyser system Consisting of in-situ dilution Probe (long 1500 mm) flange mounted, umbilical cord 1x1/4 inch teflon & 3 x 1/4th nylon pvc jacketing 100 mtr long , span/back flush, dilution air, Dilution control unit with auto calibration solenoids, pressure gauges, flow meter, air dryer with filter arrangement, calibration gas cylinders 10 ltr capacity 4 sets with rack stand, Analyser panel (800mm x 800m x 1915mm) fitted air condition & 19 inch racks, tubing & sampling panel + analysers. The tubing/ signal, control, power cabling between probe and Analyser panel is approx 100 mtrs long, 800 mmx 2100 mm (H). The probe is located at approx. 82 mt Elevation on chimney+ flue. Local PC based DAS consist of 24-inch monitor, i3 processor with key board and accessories.	Set	1	1
A.10.7	Mercury analyser consist of sample probe with heated filter, mounting flange, heated sample tubes with RTD (length 50 mtrs), span zero gas calibration cylinders, peristaltic pumps 2 nos, outdoor PLC panel size 1200mm(w) x 600mm (d) x 2000mm (h) aprox weight of panel 300 Kg, mounted on chimney at 41 mtr elevation.	Set	1	1
A.10.8	Gas Flow analyser (InSitu non-contact Cross duct type) Consisting of Transceiver unit -02 No each with air purge connections, Signal processor unit, power supply unit, display control unit, fail safe shutter with 10 mtr cable against power or purge air failure, Air Compressor Unit 2 nos with air distribution Hose for purge air connection, inter connecting power & control cables etc. The analyser mounting at elevation 65 mts and temperature transmitter at 64.75 mtrs on chimney. Location of cross duct monitor is at about 106 mtr elevation in chimney.	Set	1	1
A.11.0	STEAM AND WATER ANALYSIS (SWAS): The scope of work includes erection of main system along with the equipments and loose items indicated below, if any,			

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

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A.11.7	Laying and Termination of Power Cables to SWAS Panel/Chiller	Mtrs	50	50
A.12.0	VIBRATION MONITORING SYSTEMS			
A.12.1	Vibration Monitoring System for SG&TG at CER:			
A.12.1.1	Bearing Casing Vibration Sensors with block/pad & 10 Metre extension cables	Set	166	166
A.12.1.2	Non-Contact type Probe (Shaft Biv+Axial Shift+Phase Marker) along with extension cable & drive mounting brackets and probe Holders:	Set	67	67
A.12.1.3	Junction boxes	Nos	127	127
A.12.1.4	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	8	8
A.12.1.5	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	2	1
A.12.1.6	Three Bay VMS panel App. Size: 2250 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 1200 kg.	Nos	1	1
A.12.1.7	VMS Server/User PC	Nos	2	2
A.12.1.8	Printer	Nos	1	1
A.12.1.9	Ethernet Cable	Mtrs	200	200
A.12.2	Vibration Monitoring System for CWP/ACWP at CWP Control Room:			
A.12.2.1	Bearing Casing Vibration Sensors with block/pad & 10 Metre extension cables:	Set	57	57
A.12.2.2	Non-Contact type Probe (Shaft Biv+Axial Shift+Phase Marker) along with extension cable & drive mounting brackets and probe Holders:	Set	2	2
A.12.2.3	Junction boxes	Nos	37	37
A.12.2.4	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	2	2
A.12.2.5	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	1	1
A.12.2.8	FO Cable	Mtrs	1200	1200
A.12.2.9	Ethernet Cable	Mtrs	100	100
A.12.3	Vibration Monitoring System for APH Wash Pumps at Clarified Water Pump House and RW Pumps at RWPH Control Room:			
A.12.3.1	Bearing Casing Vibration Sensors with block/pad & 10 Metre extension cables:	Set	96	0
A.12.3.2	Non-Contact type Probe (Shaft Biv+Axial Shift+Phase Marker) along with extension cable & drive mounting brackets and probe Holders:	Set	7	0
A.12.3.3	Junction boxes	Nos	49	0
A.12.3.4	Vibration monitoring racks with modules: (To be mounted in the VMS panels)	Set	6	0
A.12.3.5	Single Bay VMS panel App. Size: 750 mm(W) X 800 mm(D) x 2117 mm(H); Approx. weight 400 kg.	Nos	2	0
A.12.3.6	FO Cable	Mtrs	6300	0
A.12.3.9	Ethernet Cable	Mtrs	100	0
A.13.0	UPS WITH ACDB & BATTERY BANK			
A.13.1	Main Plant & St-I & II: 2 X180 KVA UPS parallel redundant comprising of the following: UPS-1 , UPS 2,	Set	2	1

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	Rectifier Panel, inverter panels and Aux panel 1,2 ,with Input also. Transformer overall size 6400 mm (L) x 1000 mm(W) x 2100 mm(H) aprox weight 8000 Kg. wall mounted Battery isolation JB's size 600mm x 300mm x800mm weight 80 Kg aprox. Wall mounted BHMS Display boxes aprox size 450mm x 500mm x 150mm and accessories.			
A.13.2	415 V ACDB of size app. 6400(L)x1000(W)x2100(H) in mm and app. Wt. 850 kg.	Nos	2	2
A.13.3	Laying of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) from UPS to Battery	Mtrs	600	600
A.13.4	Laying of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) UPS to ACDB	Mtrs	1200	1200
A.13.5	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	50
A.13.6	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	5460	5460
A.13.7	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	2
A.13.8	UPS BATTERY: 1285 AH/ 360 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 433(L) x 368(W) x 682(H). App.Cell weight without electrolyte: 134 Kg & 204 kg with electrolyte. Total Qty of electrolyte: 21000 litre.	Set	2	2
A.13.9	RWPH: 2 X10 KVA UPS parallel redundant comprising of thefollowing: UPS-1 , UPS 2, Rectifier Panel, inverterpanels and Aux panel 1,2 ,with Input Iso. Transformeroverall size 2200 mm (L) x 900 mm(W) x 1870 mm(H)aprox weight 3000 kg. wall mounted Battery isolation JB'ssize 600mm x 300mm x800mm weight 80 Kg aprox. Wallmounted BHMS Display boxes aprox size 450mm x 500mmx 150mm and accessories.	Set	1	0
A.13.10	415 V ACDB of size app. 750(L)x300(W)x1250(H) in mm and app. Wt. 200 kg.	Nos	2	0
A.13.11	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Mtrs	160	0
A.13.12	Laying of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Mtrs	60	0
A.13.13	Laying and termination of 4C Shielded communication cable from MODBUS to TCP/IP	Mtrs	50	0

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A.13.14	Laying and termination of 4C Shielded communication cable from UPS to Battery Monitoring System	Mtrs	3360	0
A.13.15	Battery Health Monitoring System Panels of App.size 600 (L)x 400(W) x 600(H) and Wt. 200 kg	Nos	2	0
A.13.16	UPS BATTERY: 200 AH/ 220 V Lead Acid Plante Batteries (two banks) each bank is made up of 110 cells, housed in wooden racks along with inter cell connectors, inter block connectors, inter row connectors, cell mounting insulators,petroleum jelly and Ms lead plated fasteners, Discharge resistor bank, Each Cell dimension: 134(L) x 203(W) x 406(H). App.Cell weight without electrolyte: 13.5 Kg & 21 kg with electrolyte. Total Qty of electrolyte: 1600 litre.	Set	1	0
A.13.17	Power Distribution Boards for BOP Plant App.Dimension 400(L)x300(W)x600(H) and app. Wt. 500 kg.	Nos	2	0
A.13.18	1 kVA UPS System 230 V output, 30-90 min back up with 2/3 pin power socket with auto voltage regulator	Nos	5	0
A.14.0	LOCAL INSTRUMENT ENCLOSURES/RACKS			
A.14.1	Local Instrument Enclosures (Type - A)-Size: 1450(W) x 1000(D) x 2200 (H)mm; Approximate weight: 900 kg each	Set	20	20
A.14.2	Local Instrument Enclosures (Type - B)-Size: 1100(W) x 1000(D) x 2200 (H)mm; Approximate weight: 600 kg each	Set	36	36
A.14.3	Local Instrument Enclosures (Type - C)-Size: 700(W) x 1000(D) x 2200 (H)mm; Approximate weight: 400 kg each	Set	20	20
A.14.4	Local Instrument Racks (Type - A)-Size: 1400(W) x 650(D) x 2200(H) mm; Approximate weight: 600 kg each	Set	24	24
A.14.5	Local Instrument Racks (Type - B)-Size: 1100(W) x 650(D) x 2200(H) mm; Approximate weight: 400 kg each	Set	42	42
A.14.6	Local Instrument Racks (Type - C)-Size: 800(W) x 650(D) x 1500(H) mm; Approximate weight: 250 kg each	Set	18	18
A.14.7	Local Instrument Racks (Type - D)-Size: 1600(W) x 650(D) x 2200(H) mm; Approximate weight: 700 kg each	Set	6	6
A.15.0	LAYING AND TERMINATION OF CABLES			
A.15.1	Thermocouple Extension Cables			
A.15.1.1	2 Pair, 16 AWG, KX Type TC Extension Cable	Mtrs	10620	10620
A.15.1.2	6 Pair, 16 AWG, KX Type TC Extension Cable	Mtrs	29295	29295
A.15.1.3	2 Pair, 16 AWG, RX Type TC Extension Cable	Mtrs	2000	2000
A.15.2	Extruded HRPVC with FRLS, Armoured, Over All Shielded, Copper Cables			
A.15.2.1	2 pair x 0.5 sqmm	Mtrs	9270	9270
A.15.2.2	4 pair x 0.5 sqmm	Mtrs	25290	25290

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A.15.2.3	8 pair x 0.5 sqmm	Mtrs	14535	13770
A.15.3	Extruded HRPVC with FRLS, Armoured, Individually and overall shielded, Copper Cables			
A.15.3.1	2 pair x 0.5 sqmm	Mtrs	11970	10890
A.15.3.2	4 pair x 0.5 sqmm	Mtrs	37877	36527
A.15.3.3	6 pair x 0.5 sqmm	Mtrs	600	600
A.15.3.4	8 pair x 0.5 sqmm	Mtrs	8055	8055
A.15.3.5	12 pair x 0.5 sqmm	Mtrs	2000	2000
A.15.3.6	2 Troid x 0.5 sqmm	Mtrs	11677	11677
A.15.4	Extruded HRPVC with FRLS, Armoured, Copper control Cables			
A.15.4.1	3 C x 2.5 sqmm	Mtrs	6615	2520
A.15.4.2	5 C x 2.5 sqmm	Mtrs	3330	3330
A.15.5	TG Special Cables			
A.15.5.1	Special Cable 5 x1.5 sqmm	Mtrs	1000	1000
A.15.5.2	FEP Insulated 2x2x0.5 sqmm type-1 Cable	Mtrs	5400	5400
A.15.5.3	FEP Insulated 2x4x0.5 sqmm type-2 Cable	Mtrs	2000	2000
A.15.5.4	CAT 6/Ethernet UTP Cable	Mtrs	17700	12200
A.15.5.5	Laying of Optic Fiber cable for offsite PLC/ DCS systems and MIS connectivity	Mtrs	30000	10000
A.15.5.6	HDPE Conduits for laying OFC cables	Mtrs	6000	6000
A.15.5.7	Splicing of Optical Fibre Cable	Nos	350	200
A.16.0	CABLE TRAYS			
A.16.1	50 mm Perforated Trays with Cover	Mtrs	1500	1500
A.16.2	100 mm Perforated Trays with Cover	Mtrs	1500	1500
A.16.3	50 mm Perforated Trays without Cover	Mtrs	2000	2000
A.16.4	100 mm Perforated Trays without Cover	Mtrs	2000	2000
A.17.0	JUNCTION BOXES			
A.17.1	12 way JB	Nos	16	16
A.17.2	24 way JB	Nos	54	54
A.17.3	36 way JB	Nos	30	30
A.17.4	48 way JB	Nos	22	22
A.17.5	64 way JB	Nos	5	5
A.17.6	72 way JB	Nos	2	2
A.17.7	96 way JB	Nos	6	6
A.17.8	128 way JB	Nos	5	5
A.18.0	IMPULSE PIPES, FITTINGS, MANIFOLDS AND ACCESSORIES.			
A.18.1	ASTM A335 P91 - 1/2" NB 160	Mtrs	1000	1000
A.18.2	ASTM A106 Gr C - 1/2" NB SCH 160	Mtrs	2800	2800
A.18.3	ASTM A106 Gr C - 1/2" NB SCH 80	Mtrs	9500	9500
A.18.4	ASTM A106 Gr C - 1" NB SCH 80	Mtrs	300	300
A.18.5	ASTM A106 Gr C - 3/4" NB SCH 80	Mtrs	7600	7600
A.18.6	ASTM A335 P22 - 3/4" NB SCH 80	Mtrs	1200	1200
A.18.7	ASTM A312 TP316- 1/2" NB SCH 40	Mtrs	280	280
A.18.8	ASTM A312 TP316H - 1/2" NB SCH 80	Mtrs	700	700
A.18.9	ASTM A312 TP316H - 1/2" NB SCH 160	Mtrs	1100	1100
A.19.0	INSTRUMENT VALVES AND ACCESSORIES			
A.19.1	FGV A105 :1/2" NB-SW 800	Nos	7	7
A.19.2	FGV ASTM A182 F91 :1/2"NB-SW 3000SPL	Nos	5	5

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A.19.3	FGV ASTM A182 F22 :1/2"NB-SW, CL-1500	Nos	11	11
A.20.0	MASTER AND SLAVE CLOCK SYSTEM			
A.20.1	Redundant GPS Based Master Clock System (Card Rack System) along with Fully wired Master clock System Panel (App.Size: 800 x 800 x 2415 mm; wt. 300 kg) - 01 No., power supply unit, battery system, signal boosters, Signal Conditioners, multiplexer, FO Accessories (LIU, Duplex etc.)	Set	1	0
A.20.2	42 U Panel of size 800 mm (L)x1000mm(W)x2115(H)for housing the servers, network switches	Nos	1	0
A.20.3	Slave clock (Rs 485 based)/NTP based Approximate Size: 750(W) x56(D) x 170(H) mm for various locations	Nos	45	0
A.20.4	Redundant GPS antenna (built in LA) along with around 200 Mtrs antenna cable from antenna to GPS receiver unit and antenna fixing accessories.	Set	2	0
A.20.5	Redundant GPS Receiver/Master Clock-A and Master Clock-B with comparator and out put cards.	Set	1	0
A.20.6	Laying and termination of RG 58 Coaxial Cable FRLS armoured (Clock panel to IRIG B interfacing equipment and Clock panel to various pulses interfacing equipments)	Mtrs	7500	0
A.20.7	Laying and termination of Armoured Power Cable 3Cx2.5 sqmm	Mtrs	6300	0
A.20.8	Laying and termination of Armoured Signal Cable 2Px0.5 sqmm	Mtrs	9000	0
A.20.9	Cable - CAT 5e/CAT6 for NTP / SNTP output	Mtrs	560	0
A.20.10	FO Cable (4F) connecting FO NTP outpus multimode armoured cable	Mtrs	5000	0
A.20.11	Splicing of Optical Fibre Cable	Nos	10	0
A.20.12	Flexible GI conduit Pipe	Mtrs	500	0
A.20.13	Junction Boxes	Nos	12	0
A.21.0	LARGE VIDEO SCREEN SYSTEMS			
A.21.1	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height / arrangement etc. in Unit Control room	Set	8	5
A.21.2	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for AHP system.	Set	4	0
A.21.3	67" - 80" Large Video Screen having resolution 1920X1080 pixels with LED based rear projection	Set	4	0

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	along with CPU and other loose supplied items like Video display controller, Border binder, interconnecting power & communication cables, Mounting stand 1200 mm height /arrangement etc. for CHP system.			
A.22.0	HMI & PIS SYSTEM PACKAGE			
A.22.1	HMIPIIS for Unit DDCMIS			
A.22.1.1	Operator WorkStation	Nos	25	10
A.22.1.2	Historical Storage & Retrieval (Information) WorkStation	Nos	2	2
A.22.1.3	Programmer cum documentation station	Nos	2	2
A.22.1.4	LaserJet Colour Printer (A4 size)	Nos	3	3
A.22.1.5	LaserJet B/W Printer (A4 size)	Nos	3	3
A.22.2	HMIPIIS for AHP DDCMIS			
A.22.2.1	Operator WorkStation	Nos	2	0
A.22.2.2	Programmer cum documentation station	Nos	2	0
A.22.2.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.3	HMIPIIS for CHP DDCMIS			
A.22.3.1	Operator WorkStation	Nos	2	0
A.22.3.2	Programmer cum documentation station	Nos	2	0
A.22.3.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.4	HMIPIIS for Mill Reject System			
A.22.4.1	Operator WorkStation	Nos	1	0
A.22.4.2	Programmer cum documentation station	Nos	1	0
A.22.4.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.22.5	HMIPIIS for CW/ACW SYSTEM			
A.22.5.1	Operator WorkStation	Nos	3	0
A.22.5.2	Programmer cum documentation station	Nos	3	0
A.22.5.3	LaserJet Colour Printer (A4 size)	Nos	3	0
A.22.6	HMIPIIS for Compressed Air System			
A.22.6.1	Operator WorkStation	Nos	1	0
A.22.6.2	Programmer cum documentation station	Nos	1	0
A.22.6.3	LaserJet Colour Printer (A4 size)	Nos	1	0
A.23.0	Performance Analysis Diagnostics and Optimization (PADO) Package			
A.23.1	Computer Table	Nos	3	3
A.23.2	Chairs	Nos	3	3
A.23.3	Printer Table	Nos	1	1
A.24.0	LAB INSTRUMENTS - To be demonstrated and handing over to Customer			
A.24.1	Lab Items-I:			
A.24.1.1	Dead Weight Tester - 2 Nos, Standard Quality Pressure Gauges - 3 Set, Laboratory Type Manometer - 2 Set, Inclined Tube Manometer - 2 Set, Manometer - 2 Set, Pressure and Vaccumm Air Pump - 2 Set, Portable Pressure Comparator - 1 Set, Temperature Calibration Bath - 1 Nos, Temperature Calibrator - 3 Nos, Temperature Calibrator (Table Mounted) - 2 Nos, Hot air Blower - 1 Nos, Barometers - 1 Nos, Surface Pyrometer - 1 Nos, Pneumatic Test Bench - 2 Nos, Portable Flue Gas Analyser - 1 Set, Furnace - 1 Nos,	Set	1	0

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	Mercury Thermometer - 2 Set, Tool Kit Box - 12 Nos, Oil Condition Monitor - 1 Nos, Portable Ultrasonic Flowmeter - 2 Nos, Wet & Dry Bulp Hygrometer - 1 Nos, Flowmeter Calibration - 1 Set, Air Sets - 1 Nos, Welding Machine - 1 Nos, Jewellers Lathe - 1 Nos, Grinding Machine - 1 Set, Feeler Gauge - 1 Nos, Anemometer (Portable) - 1 Nos, Stop Watch - 1 Nos, Vibration Calibrator - 1 Nos, Precision Instrument Radial Drilling Machine - 3 Nos, Portable Drilling Machine - 1 Nos, Universal Digital Thermometer - 1 Nos, Low and Medium Pressure Controller - 1 Set, Portable Pneumatic Hydraulic Calibrator - 1 Set, Bench Vice & Hand Vice - 3 Set, Vacuum Cleaner - 1 Nos, Screw Gauge - 1 Nos, Pitot Tube - 2 Nos, Test Thermocouple - 2 Nos.			
A.24.2	Lab Instruments-II			
A.24.2.1	Portable Multifunction Calibrator (Microprocessor based) - 3 Nos, Decade Resistance Box - 2 Nos, AC Universal Bridge - 1 Nos, Signal Generator - 2 Nos, Hand Tachometer - 2 Nos, Insulation tester of Different range - 1 Nos, DC Regulated Power Supply - 4 Nos, Stop Watch (Digital Type) - 2 Nos, Continuity Tester - 10 Nos, Tong Tester - 3 Nos, High Range Tong Tester - 1 Nos, Stabilised Power Supply - 2 Nos, Stroboscope - 1 Nos, Portable Trend Recorder - 1 Nos, Electronic Test Bench with computerized calibration system - 2 Nos, Digital Oscilloscope - 2 Nos, Decade Resistance Box - 2 Nos, Digital Multimeter - 2 Nos, Function Generator - 2 Nos, Chartless Recorder - 2 Nos, Variable DC Stabilized Power Supply - 2 Nos, Variable AC Stabilized Power Supply (0-260 V, 10A) - 2 Nos, Step Down Transformer (110V, 2A) - 2 Nos, Continuity Tester - 2 Nos, Fixed Power Supply (+/- 48 V DC, 3A, +/- 24V DC, 6A, +/- 12V DC, 10A, +/- 5V DC, 5A) - 2 Nos, Electronically Operated Air Gun - 2 Nos, Digital LCR-Q Bridge - 2 Nos, Card IC Tester - 2 Nos, Soldering Station & Desoldering Station - 2 Nos, Power meter with Harmonic Analysis - 2 Nos, One set of tool box with screw driver set, Spanner, Plier Cutter - 2 Nos, Portable digital multimeter - 10 Nos, Field Transmitter Calibrator - 2 Nos, Soldering Iron with Solder Sucker - 8 Nos, DE Soldering Station - 1 Nos, VARIAC - 1 Nos, Power Pack - 2 Nos, Vibration Analyzer Balancer Instrument - 2 Nos, Portable Meter Calibrator - 2 Nos, Digital Cable Identification System - 6 Nos, Dual Beam Portable Digital Storage Oscilloscope - 2 Nos, Hand Held Thermocouple and PT-100 Ohm Simulator and Indicator - 1 Nos, Insertion and Extraction tools for various Pin Numbers 14,16 and 48 - 2 Nos, Rheostats - 1 Nos, Desktop Digital	Set	1	0

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	Multimeter - 2 Nos, Phase Sequence Meter - 1 Nos, Frequency Meter - 1 Nos, Mini Scope Meter - 1 Nos, Vibration Meter Sould Level Monitor - 1 Nos, Portable pH Calibrator - 2 Nos, Module Tester - 1 Nos, DC Regulated Power Source - 2 Nos, Auto Transformer - 1 Nos, Nickel Cadmium Cell - 1 Nos, Scanner - 1 Nos, Torximitor - 2 Nos, Laptop - 2 Nos, Portable mA Calibrator - 3 Nos, Table Mounted mA Calibrator - 2 Nos, Portable mV Calibrator - 2 Nos, Test RTD - 2 Nos, Frequency counter/Timer - 1 Nos.			
A.25.0	COMPUTER FURNITURES			
A.25.1	Unit Operator Desk (8 Section) Angular installation dimension 7960mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	1
A.25.2	Common Operator Desk (8 Section) Straight installation dimension 7600mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.25.3	CWPH Operator Desk (3 Section) Straight installation dimension 2850mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.25.4	Common & other area Operator Desk (2 Section) Straight installation dimension 1900mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	6	0
A.25.5	Computer tables with Shelf for each Unit 1000mm(L)X1650MM(H)X950MM(D)	Set	31	31
A.25.6	Computer tables with Shelf for Common & Other areas 1000mm(L)X1650MM(H)X950MM(D)	Set	5	0
A.25.7	Computer tables with Shelf for common areas 1000mm(L)X1650MM(H)X950MM(D)	Set	12	0
A.25.8	Computer tables with Shelf for MIS Clients 1000mm(L)X1650MM(H)X950MM(D)	Set	40	40
A.25.9	Computer tables without Shelf 1000mm(L)x750mm(H)x1050mm(D)	Set	2	2
A.25.10	PC Rack 1000mm(L)x1900mm(H)x900mm(D) including fixing of power sockets, MCBs, Ethernet Switches hardware, etc	Set	2	2
A.25.11	Printer Tables 735mmx900mmx600mm including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	13	13
A.25.12	Printer Tables 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	9	0
A.25.13	Printer Tables for MIS Clients 900mm(L)x735mm(H)x590mm(D) including fixing of	Set	40	40

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	power sockets, MCBs, Ethernet Switches , hardware,etc			
A.25.14	Printer Tables for MIS Servers 900mm(L)x735mm(H)x590mm(D) including fixing of power sockets, MCBs, Ethernet Switches , hardware,etc	Set	2	2
A.25.15	Computer Chair Medium back with cushioned arms	Set	85	55
A.25.16	Computer Chair Medium back with cushioned arms for MIS Clients	Set	40	40
A.25.17	Almira 1780mm x 839mm x 380mm with glass window	Set	1	1
A.25.18	Safety lock key pad 350mm x 250mm x 250mm weight 10 kg, safety rack 1830mm x 410mm x 457mm	Set	1	1
A.25.19	Operator Desk (6 Section) Straight installation dimension 5700mm (W) x 1050mm (D) x 750mm (H) including fixing of power Sockets, MCBs, ethernet switches hardware etc	Set	1	0
A.26.0	TERMINATION OF POWER CABLES			
A.26.1	Termination of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) from UPS to Battery	Nos	14	14
A.26.2	Termination of cable size UN 0000 - Uninyvin Cable (Equivalent to 1Cx109 Sqmm Copper Cable) UPS to ACDB	Nos	26	26
A.26.3	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) from UPS to Battery	Nos	4	0
A.26.4	Termination of cable size UN 4 - Uninyvin Cable (Equivalent to 1Cx21.5 Sqmm Copper Cable) UPS to ACDB	Nos	2	0
A.27.0	COMMISSIONING OF THE FOLLOWING			
A.27.1	Commissioning of Transducers- Removal and recalibration of Power, Voltage, Current, Frequency out put 4-20 mA	Nos	25	25
A.28.0	STRUCTURAL MATERIALS			
A.28.1	ISM 100, ANGLE 50X50X6 & 2.5MM THICK Plates	MT	15	15
B	BHEL TRICHY SCOPE OF SUPPLY			
B.1.0	FUEL OIL SYSTEM			
B.1.1	PD Type Mass flow meter in HFO,LDO/HSD & HFO return line with mounting flanges, electronics amplifier box, inter connecting cabling, etc.	Set	3	3
B.1.2	Pressure Gauges	Nos	72	45
B.1.3	Temperature Indicator	Nos	12	6
B.1.4	Pressure Switches	Nos	22	22
B.1.5	Level Indicator	Nos	1	1
B.1.6	Temperature Elements	Nos	2	0
B.1.7	FSSS Local Oil Gun Maintenance Switch Box	Nos	18	18
B.1.8	H.E.A Exciter box 240 V AC alongwith retractor assembly 240 V AC solenoid, flexible spark rod 133 inch, spark top, flexible cable assembly 3 mtr long, SS	Set	16	16

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	hose 6.35mmx1000mm, Air Filter Regulator 1/4 inch etc.			
B.1.9	Flame Scanner Head Assembly consisting fibre optic cable L130" lense barrel, flame processor module, Flame module, pigtail cable, pico fuse, card extender module, power supply module, 6 way JB, etc	Set	32	32
B.1.10	Microprocessor based flame scanner amplifier 8 Nos. of 19" racks of size 482x263x134 (WxDxH) to be mounted in flame scanner panel (CJF49/CJF50) supplied by EDN	Set	1	1
B.2.0	ACOUSTIC STEAM LEAK DETECTOR			
B.2.1	ASLD panel assembly and computer with monitor panel size 800mmx2315mmx800mm & App.Wt. 200 kg	Set	1	1
B.2.2	ASLD sensor assembly -30 Nos + Sonic Tube + Field Amplifier box with Module- 32 Set+ Power Supply Units-4 Nos+ JB- 1No, Calibrator-1 No, Sensor Pig tail cable-450 mtr	Set	1	1
B.3.0	FURNACE CCTV SYSTEM			
B.3.1	High Temperature Furnace Camera CCTV head assembly with advance retract mechanism and Local Control Unit panels (800mmx1000mmx300mm) with inter connecting pipes, air filter regulators, ss hose mounted at boiler 45 M elevation. Remote Control Box (600 mm x500 mmx 300 mm) with 24" monitor and accessories at CCR, 40" LED monitor & Multiplexer.	Set	2	2
B.4.0	PNEUMATIC POWER CYLINDERS (REGULATING TYPE) Installation and Commissioning			
B.4.1	Pneumatic Power Cylinders with Position Transmitters controlled from SADC (App.Weight 20 kg each)	Set	132	132
B.4.2	Pneumatic Power Cylinders with SMART Positioners controlled from DDCMIS (App.Weight 20 kg each)	Set	16	16
B.4.3	PA/ID/FD Fans Blade Pitch Control Damper with SMART Positioner controlled from DDCMIS (App.Wt. 90 kg)	Set	6	6
B.4.4	Cold Air Regulating Dampers with SMART positioner alongwith linkage rod (App.Wt. 95 kg)	Set	8	8
B.4.5	Hot Air Regulating Dampers with SMART positioner alongwith linkage rod (App.Wt. 175 kg)	Set	8	8
B.4.6	Dynavane Filter Pressure Control Damper with SMART positioner	Set	1	1
B.5.0	GRAVIMETRIC FEEDER PANEL			
B.5.1	Gravimetric Feeder Remote Power Cabinet Size 1200x2315x600 and Wt.300 kg	Nos	8	8
B.5.2	Feeder Coal flow monitor assembly flange mounted	Nos	8	8
B.5.3	Feeder Electronics including 3 Nos. of Calibration probe with cable and 100 Nos. of Retro-Reflective Tape	Set	1	1
B.6.0	STEAM/WATER/PULVERIZER/AIR/FLUE GAS LINE INSTRUMENTS			

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B.6.1	Pressure Indicators	Nos	15	15
B.6.2	DP Switches	Nos	1	1
B.6.3	Temperature Indicator	Nos	8	8
B.6.4	K-Type MTM Thermocouple 8MM OD & 8 M DUPLEX	Nos	8	8
B.6.5	K-Type MTM Thermocouple 8MM OD & 10 M DUPLEX	Nos	33	33
B.6.6	K-Type MTM Thermocouple 8MM OD & 12 M DUPLEX	Nos	38	38
B.6.7	K-Type MTM Thermocouple 8MM OD & 14 M DUPLEX	Nos	41	41
B.6.8	K-Type MTM Thermocouple 8MM OD & 16 M DUPLEX	Nos	37	37
B.6.9	K-Type MTM Thermocouple 8MM OD & 18 M DUPLEX	Nos	40	40
B.6.10	K-Type MTM Thermocouple 8MM OD & 20 M DUPLEX	Nos	63	63
B.6.11	K-Type MTM Thermocouple 8MM OD & 22 M DUPLEX	Nos	57	57
B.6.12	K-Type MTM Thermocouple 8MM OD & 24 M DUPLEX	Nos	47	47
B.6.13	K-Type MTM Thermocouple 8MM OD & 26 M DUPLEX	Nos	57	57
B.6.14	K-Type MTM Thermocouple 8MM OD & 28 M DUPLEX	Nos	16	16
B.6.15	K-Type MTM Thermocouple 8MM OD & 30 M DUPLEX	Nos	12	12
B.6.16	DP Switches	Nos	2	2
B.6.17	Level Switches High/Low	Nos	20	20
B.6.18	DP Switches High/Low	Nos	17	17
B.6.19	ERV Controller with Pressure Switch App.Dimension(mm): 400x350x190; App.Wt: 10 kg	Set	4	4
B.7.0	LAYING AND TERMINATION OF CABLES (PVC,FRLS,ARMOURED CABLES FOR SCANNER, MILL FEEDER, AC CONTROLS AND INSTRUMENTATION)			
B.7.1	FLAME SCANNER CABLE-P/O SHIELDED	Mtrs	8280	8280
B.7.2	2P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	1500	1500
B.7.3	4P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	4950	4950
B.7.4	8P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	32400	32400
B.7.5	12P X 0.5 SQMM O/A SHIELDED INST.CABLE	Mtrs	5850	5850
B.7.6	2P X 1.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	9900	9900
B.7.7	2P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	3150	3150
B.7.8	4P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	8820	8820
B.7.9	8P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	7200	7200
B.7.10	12P X 0.5 SQMM P/O SHIELDED INST.CABLE	Mtrs	4320	4320
B.7.11	3C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	500	500
B.7.12	5C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	500	500
B.7.13	7C X 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.14	9CX 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000
B.7.15	12CX 2.5 SQ.MM. ARM. CONTROL CABLE	Mtrs	1000	1000

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B.7.16	12P X 1.31 SQ. MM. EXTN. CABLE - KX	Mtrs	2700	2700
B.7.17	2P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2700	2700
B.7.18	4P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2880	2880
B.7.19	8P X 0.5 SQ.MM PTFE INST. CABLE - G	Mtrs	2000	2000
B.7.20	4P X 0.5 SQ.MM PTFE INST. CABLE - F	Mtrs	750	750
B.7.21	3C X 2.5 SQ.MM PTFE CONTROL CABLE	Mtrs	550	550
B.7.22	5C X 2.5 SQ.MM PTFE CONTROL CABLE	Mtrs	2000	2000
B.7.23	2P X 0.5 SQ.MM PTFE INST. CABLE - F	Mtrs	2600	2600
B.7.24	2P X 1.31 SQ.MM PTFE EXTENSION CABLE	Mtrs	3600	3600
B.8.0	CABLE TRAY			
B.8.1	CABLE TRAY-50 MM WIDTH	Mtrs	1750	1750
B.8.2	CABLE TRAY-100 MM WIDTH	Mtrs	5875	5875
B.8.3	CABLE TRAY-150 MM WIDTH	Mtrs	3750	3750
B.9.0	JUNCTION BOXES			
B.9.1	24 WAY FRP JUNCTION BOX WITH CANOPY	Nos	80	80
B.9.2	48 WAY FRP JUNCTION BOX WITH CANOPY	Nos	65	65
B.9.3	72 WAY FRP JUNCTION BOX WITH CANOPY	Nos	60	60
B.9.4	24 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	5	5
B.9.5	48 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	35	35
B.9.6	72 WAY MTM FRP JUNCTION BOX WITH CANOPY	Nos	10	10
B.10.0	MISCELLENEOUS RACKS/PANELS			
B.10.1	Local Instrument Enclosures/Racks with Junction Boxes, App. Size: 1650x2150x800 (mm) and App.Wt: 500 kg	Set	15	15
B.10.2	Pulveriser Dynamic Classifier - VFD Cabinet App. Size: 900x2100x700 (mm) and App.Wt: 100 kg	Nos	8	8
B.10.3	HWL-1&2 and MEF Controller JB App. Size: 600x600x250 (mm) and App.Wt: 50 kg	Nos	3	3
B.11.0	HARDWARES FOR TUBING			
B.11.1	1/4" Air Filter Regulators (for mill system)	Nos	8	8
B.11.2	1" Air Filter Regulators (for SADC System)	Nos	8	8
B.11.3	Purge Meter cum DP Regulator	Nos	16	16
B.11.4	1" OD SS TUBE	Mtrs	40	40
B.11.5	1/4" OD SS TUBE	Mtrs	4800	4800
B.11.6	3/4" OD SS TUBE	Mtrs	20	20
B.11.7	3/8" OD SS TUBE	Mtrs	55	55
B.11.8	1/4" TEFLON HOSE- 2 METER PER PIECE	Nos	135	135
B.11.9	1" TEFLON HOSE- 3 METER PER PIECE	Nos	5	5
B.11.10	1/2" TEFLON HOSE- 1 METER PER PIECE	Nos	18	18
B.12.0	MISCELLENEOUS ITEMS			
B.12.1	Structural Steel for fabrication of Supports consisting of angles, channels (ISA ISMC 100x50x6 wt 1250 kg, ISA 50x50x6 Wt. 800 kg,etc)	MT	2	2
B.12.2	1/2" GI Pipe	Mtrs	1215	1215
B.13.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
B.13.1	Heavy Duty Limit Switches for Burner Tilt Shear Pin Failure Indication Purpose	Nos	32	32

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B.13.2	HWL 1 & 2 & MEFCV Motor Starter Panel	Set	1	1
B.13.3	Motor Operated Valves (MOV) Actuators (On/Off) in Various Applications	Nos	78	78
B.13.4	Motor Operated Valves Actuators (MOV) (inching) in Various Applications	Nos	35	35
B.13.5	Electric Actuators for Various Dampers (Open/Close)	Nos	16	16
B.13.6	Pneumatic Actuators for Various Dampers(Open/Close)	Nos	17	17
B.13.7	Limit Switches (Cabling and Checking) for manually operated dampers	Nos	44	44
B.13.8	Solenoids (different ratings) of Pneumatic Valves of Various applications - tubing, Cabling & Commissioning	Nos	213	213
B.13.9	Burner Tilt Shear Pin failure indication junction box App.Dimension: 280(H)x600(L)x200(D): weight 12 kg each	Nos	16	16
B.13.10	Calibration/Commissioning of Gravimetric Feeder Comprising of Feeder C&I Equipment like motion monitor sensor, micro switches, etc. along with Feeder Integral Cabinet of App.Size 600x750x350 and Wt.75 kg , LT Motors, etc.	Set	8	8
B.14	SCR PACKAGE			
B.14.1	INSTRUMENTS			
B.14.1.1	Pressure Indicators	Nos	14	3
B.14.1.2	Level Switches H/HH	Nos	10	6
B.14.1.3	Level Transmitters	Nos	12	6
B.14.1.4	Differential Pressure Transmitters	Nos	10	8
B.14.1.5	Pressure Transmitters	Nos	51	25
B.14.1.6	Temperature Elements	Nos	44	28
B.14.1.7	Temperature Indicator	Nos	6	3
B.14.1.8	Ammonia Leak Detector	Nos	10	4
B.14.1.9	Density Analyzer	Nos	2	2
B.14.1.10	pH Analyzer	Nos	1	1
B.14.1.11	Oxygen Analyzer: Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	4	4
B.14.1.12	NoX Analyzer: Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	6	6
B.14.1.13	SoX Analyzer:Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas	Set	4	4

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	cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg			
B.14.1.14	NH3 Analyzer:Consisting of insitu,flange mounted probe and electronics-1 cabinet, Verification gas cylinder and analyser accessories such as Ref.air+Verification gas kit cabinet, signal and power cables (10m), SS tubings and fittings, Junction box, Glands for Electronics and JB, mounting flanges. App.weight of analyser is 22 Kg	Set	2	2
B.14.1.15	Flow Elements	Nos	14	14
B.14.1.16	Flow Transmitters	Nos	20	20
B.14.2	CABLES			
B.14.2.1	4P X 0.5 SQ.MM. O/A SHIELDED INST. CABLE	Mtrs	7200	7200
B.14.2.2	8P X 0.5 SQ.MM. O/A SHIELDED INST. CABLE	Mtrs	5400	5400
B.14.2.3	12P X 0.5 SQ.MM O/A SHIELDED INST. CABLE	Mtrs	900	900
B.14.2.4	2P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	2200	2200
B.14.2.5	4P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	7200	7200
B.14.2.6	8P X 0.5 SQ.MM. P/O SHIELDED INST. CABLE	Mtrs	5760	5760
B.14.2.7	3C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	2430	2430
B.14.2.8	5C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	8100	8100
B.14.2.9	9C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	1500	1500
B.14.2.10	12C X 2.5 MM ² ARMoured CONTROL CABLE	Mtrs	5400	5400
B.14.2.11	2P X 1.31 MM ² EXTENSION CABLE - KX	Mtrs	100	100
B.14.2.12	4P X 1.31 MM ² EXTENSION CABLE - KX	Mtrs	800	800
B.14.3	JUNCTION BOXES			
B.14.3.1	24 WAY JUNCTION BOX	Nos	12	12
B.14.3.2	48 WAY JUNCTION BOX	Nos	17	17
B.14.3.3	24 WAY JUNCTION BOX-FLAME PROOF	Nos	10	10
B.14.3.4	48 WAY JUNCTION BOX-FLAME PROOF	Nos	10	10
B.14.3.5	72 WAY JUNCTION BOX-FLAME PROOF	Nos	6	6
B.14.4	PUSHBUTTON STATIONS			
B.14.4.1	E-STOP PUSH BUTTON STATION	Nos	10	10
B.14.4.2	FOGGING PUSH BUTTON STATION	Nos	5	5
B.14.5	CABLE TRAYS			
B.14.5.1	Cable Trays - 50mm Perforated with accessories	Mtrs	250	250
B.14.5.2	Cable Trays - 100mm Perforated with accessories	Mtrs	125	125
B.14.6	MISCELLANEOUS RACKS/PANELS			
B.14.6.1	Local Instrument Enclosures/Racks with Junction Boxes, App. Size: 1650x2150x800 (mm) and App.Wt: 1000 kg	Set	7	7
B.14.7	SUPPORTING MATERIALS			
B.14.7.1	ANGLE (50X50X6)/CHANNEL(100X50)	MT	3	3
B.14.8	EARTHING MATERIALS			
B.14.8.1	Earth Flat (50x6)	Mtrs	125	125
B.14.8.2	Earth Wire 1.219 mm GI	Mtrs	350	350

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B.14.9	IMPULSE TUBE OD 6.35X1.6X9500-SA213TP304H with accessories	Mtrs	320	320
B.14.10	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
B.14.10.1	Motor Operated Valve (MOV) Actuators (On/Off) in various locations	Nos	8	8
B.14.10.2	Motor Operated Valves Actuators (MOV) (Regulating) in Various Locations	Nos	1	1
B.14.10.3	Unit Directional Drives	Nos	19	19
B.14.10.4	Pneumatic Operated On/Off/Control Valves with accessories	Set	30	11
C	BHEL-PIPING CENTRE SCOPE OF SUPPLY			
C.1.0	Local Instruments			
C.1.1	Pressure Gauges	Nos	40	40
C.1.2	Temperature Gauges	Nos	104	104
C.1.3	Thermowells (Screwed and Welded)	Nos	197	197
C.1.4	Level Gauges	Nos	5	5
C.1.5	Sight Flow Glasses	Nos	56	56
C.1.6	Averaging Pitot Tube	Set	3	3
C.2.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
C.2.1	Control Valves - for LP Start Up Systems & SCAPH Sysyems - including Air Filter Regulators, Positioners, Testing upto DCS	Set	5	5
C.2.2	MOV Actuators for SCAPH, CW Aux Steam,etc	Nos	16	16
C.2.3	LT Drives: Condensate Drain Pumps, Emergency Fill Pumps	Nos	5	5
D	BHEL RANIPET SCOPE OF SUPPLY			
D.1	OPACITY MONITOR			
D.1.1	Opacity Monitoring System consisting of Sender/Receiver/Ref/Control Unit 1 No. each, 5 Metre Slave wire cable-1 No., Purge Air Blower with filter-1 No., Power JB-1 No., Weather Hood Cover for Purge Air Blower JB-1 No., Fully auto. Electric Operated Fail Safe Shutter-2 Nos., Differential Pressure Switch-2 Nos., Mounting Flange With Pipe - 2 Nos., Weather Hood Cover for Sender/Receiver Units - 2 Nos., Weather Hood Cover for Power JB-2 Nos. & Purge Air Hose	Set	4	4
D.2.0	AUTOMATIC LEAKAGE CONTROL SYSTEM-Air Pre Heater			
D.2.1	ALCS DCS panel 750x750x2067 mm. App. Wt.90 kg	Nos	1	1
D.2.2	ALCS Drive Control Panel 680x400x1053 mm App.Wt.50 kg	Nos	6	6
D.2.3	ALCS Controller with panel 370x210x520 mm App. Wt. 5 kg	Nos	6	6
D.2.4	Sensor Electronic with Enclosure 140x100x70 mm	Nos	6	6
D.2.5	Interfacing Box 140x100x70 mm App.Wt.5 kg.	Nos	6	6
D.2.6	Shielded Teflon Cable for ALCS	Mtrs	30	30
D.3.0	Instruments of APH/Fans/Gates & Dampers			

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D.3.1	Pressure Switches	Nos	4	4
D.3.2	Pressure Indicators	Nos	24	24
D.3.3	RTD With Thermowell	Nos	8	8
D.3.4	Temperature Indicator	Nos	10	10
D.3.5	Flow Indicating Switch	Nos	4	4
D.3.6	Go Switch	Nos	2	2
D.3.7	Dial Thermometer	Nos	2	2
D.3.8	Temperature Elements	Nos	12	12
D.3.9	Thermocouple with Thermowell	Nos	56	56
D.3.10	On/Off Switch Box including light assembly and interconnecting heat resistant cable	Set	2	2
D.3.11	Temperature Indicators-Fans	Nos	24	24
D.3.12	RTDs with Thermowell-Fans	Nos	64	64
D.3.13	Pressure Gauges-Fans	Nos	2	2
D.3.14	Pressure Transmitters-Fans	Nos	2	2
D.3.15	Angular Position Transmitters-For FD/ID/PA Fans	Nos	6	6
D.3.16	Pressure Switches-GAD	Nos	10	10
D.4.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
D.4.1	Electric Actuators for Various Dampers (Open/Close)	Nos	76	76
D.4.2	Pneumatic Actuators for Various Dampers (Open/Close)	Nos	27	27
D.4.3	Solenoid Valves for APH	Nos	2	2
D.4.4	Lub Oil Skids for Air Preheater: The scope of work includes removal of instruments, calibration, refixing, checking cable connection from JB to instruments etc. The app. Quantity of instruments for each skids given below: Pressure Gauges-2 Nos. Temperature Gauges-2 Nos., Flow Switches-2 Nos.	Set	4	4
D.4.5	Fan Motor Bearing Temperature Indicators for all fans (Removal, Calibration and refixing only)	Nos	24	24
D.4.6	Fan Motor Bearing/Winding RTDs (Checking of healthiness only)	Nos	64	64
D.4.7	Lub Oil Skids for FD Fans: The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantityof instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Sensing Elements: -3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-01 No., Pr. Gauge-3 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 02 No.	Set	2	2
D.4.8	Lub Oil Skids for ID Fans: The scope of work includes removal of instruments for calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantityof instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos.	Set	2	2

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	Temperature Elements - 3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-1No., Pr. Gauge- 6 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 05 Nos.			
D.4.9	Lub Oil Skids for PA Fans: The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc. The approximate total quantity of instruments for the skid put together is given below: Tank instrumentation Level transmitters (contact type guided wave)-3 Nos. Temperature Elements- 3 Nos, Temp. Gauge - 2 Nos, DP Transmitter - 1 No., DP Indicator-1 No., Pr. Gauge- 6 Nos, Pr. Transmitters-2 Nos, Flow Indicator with flow transmitters - 05 Nos.	Set	2	2
E	BHEL-HYDERABAD SCOPE OF SUPPLY			
E.1.0	TG INSTRUMENTS			
E.1.1	Pressure Gauges	Nos	46	46
E.1.2	Differential Pressure Gauges	Nos	4	4
E.1.3	Pressure Transmitters	Nos	46	46
E.1.4	Pressure Switches	Nos	3	3
E.1.5	RTDs with Thermowell	Nos	18	18
E.1.6	Chromel alumel Type Thermocouple	Nos	15	15
E.1.7	Level Gauges (Reflex Type)	Nos	1	1
E.1.8	Level Transmitters (Guide Wave Radar Type, top mounted)	Nos	2	2
E.1.9	Speed Measuring Loop with probe	Nos	3	3
E.1.10	Proximeter Units, Local Field Cable etc. for Governing Sytem	Set	18	18
E.1.11	E/P Transducers	Nos	4	4
E.2.0	DRIP PUMP/CWP/TDBFP/CEP INSTRUMENTS			
E.2.1	Temperature Gauge	Nos	2	2
E.2.2	Pressuer Gauges	Nos	10	10
E.2.3	Pressure Switch	Nos	5	5
E.2.4	Flow Transmitters	Nos	5	5
E.2.5	Reverse Rotation Indicators	Nos	2	2
E.2.6	Flow Glass Indicators	Nos	5	5
E.2.7	Level Glass Indicators	Nos	5	5
E.2.8	Temperature Elements (RTDs)	Nos	81	81
E.2.9	Thermowells	Nos	6	6
E.3.0	HEAT EXCHANGERS (LP & HP Heaters) &DEAERATORS			
E.3.1	Pressure Gauges	Nos	12	12
E.3.2	Level Gauges	Nos	14	14
E.3.3	Level Switches	Nos	3	3
E.3.4	Thermowell	Nos	8	8
E.3.5	Bimetallic Temperature Gauges	Nos	6	6
E.4.0	PANEL/FIELD MOUNTED INSTRUMENTS			
E.4.1	TSI System for BFP Drive Turbine and gear box consisting of the following: Configuration of Laptop with software-1 No., Monitor Rack with Modules (to be	Set	2	2

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	mounted on CWW panel) app. Wt. 40 kg per rack-1 Set, relative shaft vibration sensor probes 8mm reverse mounted Turbine and gear box-8 Nos, Axial Displacement Probes-3 Nos., Eccentricity Probe-1 No., Zero Speed Probe - 1 No., Key phasor-1 No., Bearing housing vibration Probes-4 Nos., Differential Expn. Probe -1 No., Casing Expansion-1 No., with probe extension cables-18 Nos., Probe drivers for VIBR-17 Nos., Driver Housing -12 No., JB - 3 Nos., Flexible conduits-150 Mtr., Cable seal, Cable connectors, Mounting brackets for vibration/differential exp/brg housings, RS485 cable with connector for DCS 35 Mtr long etc and calibration kit.			
E.4.2	Fabrication of Local Instrument Racks, each of size 1500x1700mm with the following materials Channel (100x50mm), Angle (50x50x6mm), 4mm Thick Sheet (400x120mm) and 10mm Thick Plate (375x770mm).	MT	2	2
E.4.3	Temperature Indicators of BFP, CEP (Removal, Calibration & Refixing only)	Nos	8	8
E.4.4	Erection and Commissioning of Oil Purification Control Panel of Size 550 (W)x250(D)x1315(H) of App. Wt. 100 kg	Nos	1	1
E.5.0	LOCAL GAUGE BOARD (LGB) / LOCAL INSTRUMENT RACK (LIR) (including removal, calibration and re-fixing of LGB mounted instruments)/JB			
E.5.1	LGB (LGB -1)Assembly for Feed Water Service for TDBFP/MD BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1100 x900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Pressure Gauge: 4 Nos.DP Gauges: 2 Nos.Temperature Gauges: 2 Nos.	Set	3	3
E.5.2	LGB (LGB-2) Assembly for SW & Cooling Water Service of TD/MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Temperature Gauges: 8 Nos. Pressure Gauge - 1 Nos. DP Gauges - 3	Set	3	3
E.5.3	LGB (LGB-2) Assembly for Lub oil service of TD / MD Booster Pump & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's.Approximate Size 1100 x 900 x 2200 mm ; Weight = 600 kg each.Quantity of instruments per set is Temperature Gauges: 4 Nos. Pressure Gauge - 4 Nos.	Set	3	3
E.5.4	LGB (LGB-1) Assembly for 3 Nos. CEP instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's.Quantity of instruments per set is Pressure Gauges: 6 Nos..Diff. pressure Gauges: 3	Set	1	1

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	Nos.temp. gauge qty 3 nos Approximate Size 1100 x 900 x 2200 mm; Weight = 600 kg each			
E.5.5	Local instrument rack (LIR) assembly for TDBFP/MDBFP Transmitters. This LIR includes PT & DPTs,tubing , fittings, JBs, Main-fold valves and wiring from JBs to transmitters. Approximate Size 2000 x 650 x 2150 mm; Weight = 350 kg. Quantity of instruments per set is DP transmitters: 05 Nos.Pressure transmitter : 05 Nos.	Set	3	3
E.5.6	Local Instrument Rack (LIR) assembly for CEP-A,B&C pumps to mount Pr. Transmitters. This LIR includes Transmitters, tubing, fittings, JBs, Manifolds Valves Approximate Size: 2000 x 600 x 2150 mm;and wiring from JBs to transmitters Weight = 300 kg Quantity of instruments per set is Pressure transmitters: 9 Nos, DP transmitters : qty 3 nos	Set	1	1
E.5.7	24 Terminals JB for Thrust Bearing RTDs	Nos	6	6
E.6.0	SUPPORT MATERIALS			
E.6.1	Structural steel (ISMC 100 x 50 mm qty 20 mtrs, Angle 45 x 45 x 5 mm-qty 24 mtrs etc.)	MT	0.5	0.5
E.6.2	Impulse Tube Dia 16X2.6 (CS) for BFP/CEPs	Mtrs	1900	1900
E.6.3	SS tube 12.7x2.1	Mtrs	750	750
E.6.4	SS tube 6x1.5	Mtrs	35	35
E.7.0	Cables/Cable Trays for BFP/CEPs			
E.7.1	4 Pair x 0.5 sqmm cable	Mtrs	500	500
E.7.2	Perforated Cable Tray 50 mm Wide	Mtrs	80	80
E.7.3	Perforated Cable Tray 150 mm Wide	Mtrs	45	45
E.8.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
E.8.1	Mill Motor Temperature Indicators (Removal, Calibration & Fixing)	Nos	16	16
E.8.2	Mills Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Transmitter-03 Nos., Temperature Elements-09 Nos., Temp.Gauges-02 Nos., DP Transmitters- 01 No., DP Indicator-01 No., Pressure Gauge-3 Nos., Pressure Transmitters- 03 Nos. and Flow Transmitter-06 Nos.	Set	8	8
E.8.3	LT Drives of Lub Oil Skid of Mills	Nos	16	16
E.8.4	Turbine Lub Oil Purification Skid: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Switch-02 Nos., Temperature Elements-02 Nos., Temp.Gauges-03 Nos., DPI with Switch- 01 No., Pressure Gauge-04 Nos.	Set	2	2
E.8.5	LT Drives of Oil Purification Skid of Turbine	Nos	2	2

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E.8.6	Control Valves with Smart Positioner, AFR, Limit Switches, inbuilt Position Transmitters, Junction Box, etc	Set	8	8
E.8.7	TDBFP Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid. Equipment per Set: Level Transmitter-02 Nos., Temperature Elements-09 Nos., Temp. Gauges-15 Nos., DP Transmitters- 02 No., DP Indicator-02 No., Pressure Gauge-17 Nos., Pressure Transmitters- 08 Nos. and Pressure Switch-02 Nos.	Set	2	2
E.8.8	LT Drives of TDBFP System	Nos	18	18
E.8.9	MOV Actuators for TDBFP System	Nos	26	26
E.8.10	MDBFP Lub Oil System: - Removal, Calibration and re-fixing of following instruments, Checking of Wiring from skid Junction Box to Equipment in Lub Oil skid and commissioning of the system. Equipment per Set: Level Transmitter-01 Nos., Temperature Elements-33 Nos., Temp. Gauges-18 Nos., DP Transmitters- 01 No., DP Indicator-01 No., Pressure Gauge-08 Nos. and Pressure Transmitters- 02 Nos.	Set	1	1
E.8.11	LT Drives of MDBFP System	Nos	9	9
E.8.12	Hydraulic Coupling of MDBFP: The scope of work covers a) Removal, calibration & re-fixing of following instruments. Pressure Indicators: 2 Nos. DP Indicator: 1 No. Temperature Indicators: 14 Nos. Pressure Transmitters: 6 Nos. Level transmitter: 1 No. DP transmitter: 1 No. RTDs (Checking only): 18 Nos. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. C) Commissioning of Speed Indicators etc.	Set	1	1
E.8.13	Governing Console Board: The scope includes removal, calibration and re-fixing of Instruments, wiring etc. Size of panel 1200 x 1650 x 450 mm The approximate quantity of instruments is Pressure Gauges: 10 Nos. Pressure Switches: 24 Nos.	Set	1	1
F	VOID			
G	BHEL-HARIDWAR SCOPE OF SUPPLY			
G.1.0	GENERATOR AUXILIARY CONTROL CABINETS-INSTALLATION AND COMMISSIONING			
G.1.1	Moisture Measurement System for Generator, including indicator cum controller placed in control room 144 x 72 and sampling system in field 760 x 600 x 210. Weight : 100 Kg	Set	2	2
G.1.2	Gen end vibration monitoring cabinet (CXW01E) dimension 800mm(W) x 600mm (D) x 2200mm (H) Including preamplifier units, special cables	Set	1	1

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	interconnecting, PC based monitor and printer computer table etc.aprox weight 150 kg			
G.1.3	Grounding Brush Monitor (Wall mounted) Approx. size & weight : 235 x 235 x 285 mm; 100 Kg.	Set	1	1
G.2.0	INSTALLATION AND COMMISSIONING OF GENERATOR INSTRUMENTS:			
G.2.1	Pressure Gauges	Nos	33	33
G.2.2	Temperature Gauges	Nos	15	15
G.2.3	Pressure Transmitters	Nos	29	29
G.2.4	Differential Pressure Transmitters	Nos	1	1
G.2.5	Differential Pressure Indicators	Nos	2	2
G.2.6	Differential Pressure Switch	Nos	6	6
G.2.7	Flow Meters	Nos	8	8
G.2.8	Flow Switches	Nos	2	2
G.2.9	Level Indicator	Nos	1	1
G.2.10	Level Transmitter	Nos	1	1
G.2.11	Position Transmitters	Nos	2	2
G.2.12	Level Switches (capacitance type)	Nos	19	19
G.2.13	RTDs	Nos	165	165
G.2.14	Pressure Switches	Nos	2	2
G.2.15	Thermocouples (NiCrNi) (Generator Bearing Temp: 4 Nos.& Exciter Bearing Temp: 2 Nos.)	Nos	18	18
G.2.16	Conductivity Sensor with Transmitter	Nos	4	4
G.2.17	Limit Switches	Nos	8	8
G.3.0	REMOVAL, CALIBRATION & REFIXING OF GENERATOR INSTRUMENTS			
G.3.1	Pressure Gauges	Nos	13	13
G.3.2	DP Gauges	Nos	2	2
G.3.3	Temperature Gauges	Nos	8	8
G.3.4	Pressure Transmitter	Nos	5	5
G.3.5	DP Transmitter	Nos	5	5
G.3.6	Pressure Switches	Nos	8	8
G.3.7	Level Switches	Nos	6	6
G.3.8	Flow Meters	Nos	8	8
G.3.9	Conductivity Cells	Nos	3	3
G.3.10	PW Conductivity Indicator	Nos	1	1
G.3.11	Checking the healthiness of the RTDs/Thermocouples	Nos	180	180
G.4.0	LAYING AND TERMINATION OF POWER CABLES FOR 24 V SOLENOIDS			
G.4.1	4Cx2.5 Sqmm	Mtrs	12960	12960
G.5.0	LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON GENERATOR PIPINGS			
G.5.1	Vacuum Switches	Nos	2	2
G.5.2	Pressure Gauges	Nos	7	7
G.5.3	Pressure Switches	Nos	1	1
G.5.4	PT RTD, Duplex Type	Nos	2	2
G.5.5	Dial Thermometer	Nos	5	5
G.6.0	LOOSE SUPPLIED INSTRUMENTS TO BE INSTALLED AND COMMISSIONED ON H2 COOLER PIPINGS			
G.6.1	Pressure Gauges	Nos	8	8

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G.6.2	Pressure Switches	Nos	1	1
G.6.3	PT RTD, Duplex Type	Nos	17	17
G.6.4	Moisture Sensor Probe	Nos	2	2
G.6.5	Dial Thermometer	Nos	6	6
G.7.0	LOOSE ITEMS TO BE INSTALLED AND COMMISSIONED ON UCB			
G.7.1	Analog/Digital Indicators	Nos	10	10
G.7.2	Bar Graph Indicators	Nos	5	5
G.7.3	Pressure Indicators (Moving Coil Type)	Nos	2	2
G.7.4	Temperature Indicator (Moving Coil Type)	Nos	2	2
G.7.5	Vibration Indicator along with Selector Switch	Nos	4	4
G.8.0	TURBINE INSTRUMENTATION GAUGES AND SENSORS			
G.8.1	RTDs	Nos	13	13
G.8.2	Thermocouples (for MAV,LBA,LBB,LBG,PGB,MAW,MAA,MAB,MAN etc	Nos	138	138
G.8.3	Thermocouples routed alongwith innercasing as per drawing only installation and healthiness checking for TSE, IPC exhaust, LPC outer, LPC-2 outer etc	Nos	9	9
G.8.4	Temperature Gauges	Nos	19	19
G.8.5	Pressure Transmitters / Absolute Pressure Transmitters	Nos	70	70
G.8.6	Differential Pressure Transmitter	Nos	6	6
G.8.7	Pressure Switches	Nos	13	13
G.8.8	Temperature Switch (Main oil Tank)	Nos	2	2
G.8.9	Differenital Pressure Switches	Nos	6	6
G.8.10	Pressure Gauges	Nos	47	47
G.8.11	Level Transmitters with amplifire, bar probe	Nos	6	6
G.8.12	Level Switches	Nos	18	18
G.8.13	Limit Switches	Nos	11	11
G.8.14	Positon Transmitters	Nos	36	36
G.8.15	Speed Sensors	Nos	9	9
G.8.16	Level Indicator	Nos	6	6
G.8.17	Emergency Push Button at CCR, Turbine Hall, LPBP	Nos	12	12
G.9.0	PRESSURE INSTRUMENTS RACKS			
G.9.1	Instrument rack TYPE A 2150mm(W) x 700mm(D) x 2150mm(H)	Set	6	6
G.9.2	Instrument rack TYPE B 1250mm(W) x 700mm(D) x 880mm(H)	Set	4	4
G.10.0	IMPULSE PIPES - TURBINE			
G.10.1	SEAMLESS C.S.TUBE 21.3X2.3 ST-BQ-A1-CDS-TUBE	Mtrs	200	200
G.10.2	CARBON STEEL TUBE 88.9x4 ST-B-HFSPIPES (RACK OF COND.INST.)	Mtrs	80	80
G.10.3	SEAMLESS C.S. TUBE 21.3X2.3 ST-BQ-A1-CDS-TUBE (RACK OF EXT & GLAND SEAL INS)	Mtrs	150	150
G.10.4	SEAMLESS C.S.TUBE 21.3x2.3 ST-BQ-A1-CDS-TUBE (RACK OF WATER INJECTION INST.)	Mtrs	120	120
G.10.5	SEAMLESS A.S. TUBE D=13.5X2.6 ST-2.25 CR-1MO-TUBE (TEMP. & PR. CONNECTION)	Mtrs	20	20

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G.10.6	S.L TUBES (GR.T22)21.3X2.77 ST-2.25 CR-1MO-TUBE (RACK OF EXT & GLAND SEAL INS)	Mtrs	60	60
G.10.7	GR:T91 (13.5X2.6) HTS -ALY- ST-TUBE (TEMP. &PR. CONNECTION)	Mtrs	10	10
G.10.8	SEAMLESS TUBE GR.T91 21.3x7.47 HTS -ALY-ST-TUBE (RACK OF MS PR.INSTRUMENTS)	Mtrs	350	350
G.10.9	SEAMLESS A.S. TUBE 21.3X2.77 HTS -ALY- ST-TUBE (RACK OF HRH/MS PR.INSTRUMENTS)	Mtrs	200	200
G.11.0	JUNCTION BOXES-TO BE INSTALLED AND COMMISSIONED			
G.11.1	Junction Box (to be mounted as per hardwar drg)	Nos	16	16
G.11.2	JB for thermocouple HPT, IPT, LPT1&2, TSE, IPC exhaust, LPC outer etc	Nos	12	12
G.11.3	Push button for TG and lube oil room	Nos	12	12
G.11.4	STRUCTURAL STEEL (for both turbine and generator instruments) 50x50x6 angle	MT	1	1
G.12.0	INSTRUMENTS FOR HEAT EXCHANGERS (CONDENSER, GSC, LP HEATER-1, TOC, CFC)			
G.12.1	Level Switches (Float type)	Nos	12	12
G.12.2	Temperature Gauges	Nos	16	16
G.12.3	Pressure Gauges	Nos	4	4
G.12.4	Level Gauges	Nos	8	8
G.12.5	MIS type Thermometer	Nos	12	12
G.12.6	Thermowell (125/175/325)	Nos	52	52
G.13.0	VOID			
G.14.0	VOID			
G.15.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
G.15.1	Condenser Vacuum Pump Removal, calibration and commissioning of CVP skid mounted instruments including CVP PLC and motor mounted on the skid. The approximate quantity of skid mounted instruments shall be Pressure Transmitters - 02 Nos., Pressure Indicators – 04 Nos., Temperature Transmitters - 03 Nos., Temperature Indicators - 04 Nos., Flow Indicator cum Switch – 01 No., Level Indicator-1 No., Rotameter-01 No., Level Switches – 02 Nos., DP Switch – 1 , Diff. Pr.Indicator-01 No., Junction Box-1 No. & Temperature Element-02 Nos., Pneumatic Butterfly Valve-01 No.,	Set	2	2
G.15.2	LT drives for Vaccum pump, Recirculation pump,	Nos	4	4
G.15.3	Oil Centrifuge Unit - Removal, calibration and refixing of all instruments mounted on centrifugal unit, checking and commissioning of the system.	Set	2	2
G.15.4	NRV Valves, Stop Valves, Control Valves, HP/LP Bypass Valves with accessories	Set	40	40
G.15.5	Position Transmitters (Removal, calibration and re-fixing)	Nos	19	19
G.15.6	Limit Switch (checking only)	Nos	76	76

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G.15.7	Solenoid Valves (checking only) (steam turbine ext.valves & condenser)	Nos	61	61
G.15.8	Motorized temperature control valve with accessories for cold gas	Nos	1	1
G.15.9	Motorized temperature control valve with accessories for primary water	Nos	1	1
G.15.10	Turbine speed monitor consisting of switch amplifier, measuring converter diode clamp Hydraulic Speed Control Equipment Rack (LR1)	Set	1	1
G.15.11	Governing System Control rack : Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below: Pressure Gauges : 9 Nos. Pressure Switches : 4 Nos.	Set	2	2
G.15.12	LP Bypass Control Rack/Skid: Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below Transmitters(Pressure, Temp &Level)-7 Nos. Switches(Pressure, DP& Flow)-6 Nos. Pressure gauges:5 Nos	Set	1	1
G.15.13	Supply Unit Racks for HP Valve-1, HP Valve-2, IP Valves (SU1, SU2 & SU3) Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. Total quantity of instruments for all 3 racks is as below: Pressure Gauges : 8 Nos. Pressure Switches: 5 Nos DP Switches : 2 Nos. Pressure transmitters :3 Limit switch:3	Set	1	1
G.15.14	Seal Oil Rack	Set	1	1
G.15.15	Stator Water Rack	Set	1	1
G.15.16	Seal Oil Level / PrTxx Instrument Rack	Set	1	1
G.15.17	Stator Water DP Instrument Rack	Set	1	1
G.15.18	H2 Dryer Unit	Set	1	1
G.16.0	LAYING AND TERMINATION OF INSTRUMENTATION CABLES			
G.16.1	Overall Shielded Cable			
G.16.1.1	2P x 0.5 sqmm	Mtrs	13500	13500
G.16.1.2	4P x 0.5 sqmm	Mtrs	9450	9450
G.16.1.3	8P x 0.5 sqmm	Mtrs	3150	3150
G.16.1.4	12P x 0.5 sqmm	Mtrs	1350	1350
G.16.1.5	2P x 0.5 sqmm (Cu braided)	Mtrs	5850	5850
G.16.1.6	4P x 0.5 sqmm (Fire Survival)	Mtrs	3150	3150
G.16.2	Individual & Overall Shielded Cable			
G.16.2.1	4P x 0.5 sqmm	Mtrs	6300	6300
G.16.2.2	8P x 0.5 sqmm	Mtrs	11700	11700
H	BHEL-BHOPAL SCOPE OF SUPPLY			
H.1.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			

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H.1.1	PT 100 Simplex/Duplex - 3 Wire/4 Wire RTD Sensors for winding/bearings of MDBFP/Drip Pump/CEP/CWP/Mill/DMCW/ACW,etc Motors	Nos	789	717
H.1.2	Electric Actuators for various sizes of Valves	Nos	51	39
H.1.3	11 kV HT Drives ID/FD/PA/MDBFP - Each 2 Nos., CW Pump- 5 Nos	Nos	7	7
H.1.4	3.3 kV HT Drives DMCW(TG)/CEP/ACW - 3 Nos each., Mills-8 Nos, BCW-1 No., Drip Motor 2 Nos.	Nos	22	22
H.1.5	3.3 kV HT Drives of other applications (Stage wise)	Nos	16	0
I	VOID			
J	BHEL-PEM SCOPE OF SUPPLY			
J.1.0	Instruments			
J.1.1	Ultrasonic Flow Transmitter with Controller (Raw Water/Ash Water/CW & ACW)	Nos	14	0
J.2.0	Laying and Termination of I/O Shielded, Screened, Twisted Pair, Type F Armoured Instrumentation Cables			
J.2.1	4 Pair x 0.5 sqmm	Mtrs	59400	59400
J.2.2	8 Pair x 0.5 sqmm	Mtrs	40500	40500
J.2.3	12 Pair x 0.5 sqmm	Mtrs	8640	8640
J.2.4	20 Pair x 0.5 sqmm	Mtrs	8640	8640
J.3.0	Laying and Termination of Overall Shielded, Screened, Twisted Pair, Type G Armoured Instrumentation Cables			
J.3.1	2 Pair x 0.5 sqmm	Mtrs	50580	50580
J.3.2	4 Pair x 0.5 sqmm	Mtrs	40680	40680
J.3.3	8 Pair x 0.5 sqmm	Mtrs	102960	102960
J.3.4	12 Pair x 0.5 sqmm	Mtrs	20700	20700
J.4.0	Commissioning of the following (including cabling, tubing, fixing AFR, Speed Regulators as applicable, checking and commissioning)			
J.4.1	Control Valves with Smart Positioner, AFR, Air Lock Valve etc., LO TCV, Gland Steam inlet and dump	Set	29	29
J.4.2	Electric Actuators for Butterfly Valves	Nos	2	2
J.4.3	Oxygen Dosing Skid for CPU/Dearator O/L - Approximate qty of instruments per skid is Pressure Gauges: 03 Nos., Mass flow controllers- 02 Nos., Pressure Safety Valve - 2 nos. Pressure Transmitter: 6 Nos., Solenoid Valves : 5 No. Junction boxes: 2 Nos, oxygen cylinders - 8 Nos + 11 loose cylinders	Set	2	2
J.4.4	Ammonia Dosing Skid - Approximate qty of instruments per skid is Pressure Gauges: 08 Nos., Level Gauge- 04 Nos, Pressure Transmitter: 04 Nos, level Transmitter: 06 Nos Differential Pressure indicating Transmitter - 02 Nos & Solenoid Operated Gate Valves - 06 Nos.	Set	1	1
J.4.5	NaOH Dosing Skid - Approximate qty of instruments per skid is., Pressure Gauges-03 Nos., Level Gauge- 01 Nos, Level Transmitters: 02 Nos. Pressure transmitter-02 Nos. & Solenoid Operated Gate Valves - 02 Nos.	Set	1	1

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J.4.6	Hydrazine dosing system Approximate qty of instruments per skid is Pressure Gauges: 08 Nos., Level Gauge- 04 Nos, Pressure Transmitter: 04 Nos, level Transmitter: 06 Nos Differential Pressure Transmitter-02 Nos. & Solenoid Operated Gate Valves - 06 Nos.	Set	1	1
J.5.0	Citric Acid Cleaning for Boiler - Installation and Removal			
J.5.1	Temp. Gauges	Nos	2	2
J.5.2	Pressuer Gauges	Nos	2	2
J.5.3	Thermocouple Stem type and MTM	Nos	8	8
J.5.4	Junction Boxes	Nos	3	3

NOTE:

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

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VOLUME-IA PART –I CHAPTER –X GENERAL

1.10.0.0	GENERAL (latest BOCW & other statutory to be added)
1.10.1.0	The scope of the work will comprise of but not limited to the following. All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.
1.10.1.1	Bidders are requested to furnish the following at PSSR-HQ immediately after release of Letter of Indent (LOI). a. Security Deposit and Additional Security Deposit b. Unqualified Acceptance of Detailed LOI/Work Order. c. Rs.100/- Stamp paper for preparation of Contract Agreement
1.10.1.2	Bidders are requested to furnish the proof of documents for the following at PSSR-Site. a. Provident Fund (PF) Registration Number b. Labour License Number c. Workmen Insurance Policy Number
1.10.1.3	In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following.
1.10.2.0	BOCW ACT & BOCW WELFARE CESS ACT
1.10.2.1	The Contractor should register their establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice of commencement / completion of building other construction Work) to the respective labour authorities i.e., a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.–NTPC, NTPL etc. b) Inspector of Factories in respect of the project premises which is under the purview of State Govt.
1.10.2.2	The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL.
1.10.2.3	The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipment's, canteen, rest room, drinking water, Toilets, ambulance, first aid center etc.

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1.10.2.4	The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.
1.10.2.5	Contractor shall make remittance of the BOCW cess as per the Act in consultation with BHEL as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and contribution of Beneficiaries remitted.
1.10.2.6	Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as it deems fit. Only upon total compliance to the BOCW Act and also discharge of total payment of Cess under the BOCW Cess Act by the Contractor, BHEL shall consider refund of the Amounts
1.10.2.7	In case of non-compliance to BOCW Act & BOCW Welfare Cess Act, BHEL reserves the right to effect recoveries as applicable.
1.10.3.0	PROVIDENT FUND & MINIMUM WAGES
1.10.3.1	The contractor is required to extent the benefit of Provident Fund to the labour employed by them in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, contractor is hereby required to get themselves registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and the code number allotted to them by the Provident Fund authorities shall be furnished to our office within one month from the date of issue of this letter of indent. In case contractor are exempted from such remittance, an attested copy of authority for such exemption is to be furnished. Please note that in the event of their failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to BHEL by the customer or paid to statutory authorities by BHEL, such amount will be recovered from payments due to the contractor.
1.10.3.1	The contractor shall ensure the payments of minimum labour wages to the workmen under them as per the rules applicable from time to time in the state.
1.10.3.2	The final bill amount would be released only on production of clearance certificate from PF / ESI and labour authorities as applicable.
1.10.4.0	OTHER STATUTORY REQUIREMENTS
1.10.4.1	The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no along with the first running bill.

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1.10.4.2	The contractor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r78(1)(a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with Challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.
1.10.4.3	The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.
1.10.4.4	The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workman under I D Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act 1948 (If applicable) to BHEL along with the Final Bill.
1.10.4.5	In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.
1.10.4.6	In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.
1.10.5.0	DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.
1.10.5.1	The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training. Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of

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	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.
1.10.6.0	OTHER GENERAL REQUIREMENTS
1.10.6.1	The scope of specification covers the installation, testing and commissioning of the erected equipment / instrument along with accessories as detailed in Bill of Quantity.
1.10.6.2	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.
1.10.6.3	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.
1.10.6.4	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.
1.10.6.6	The contractor shall have valid ELECTRICAL LICENCE as required to carry out the scope of work indicated in the BOQ.
1.10.6.7	All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

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1.10.6.8	Contractor shall erect all items/materials etc. as per sequence prescribed by BHEL at site. BHEL engineer depending upon the availability of materials/work fronts etc. will decide the sequence of erection/commissioning methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of erection/commissioning adopted in erection/commissioning of similar job or for any reasons whatsoever.
1.10.6.9	Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations and Field quality plans of BHEL.
1.10.6.10	The contractor shall co-ordinate and provide assistance for satisfactory testing, pre-commissioning, commissioning and trial run of the connected equipment under overall guidance of BHEL and shall locate any cause of malfunction and rectify the same for proper operation. Testing shall also include any additional tests, which the Engineer feels necessary because of site conditions and also to meet system specification.
1.10.6.11	During the course of erection, testing and commissioning certain rework / modification/ rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and/ or units under erection and commissioning and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously. Payments for such works shall be governed by Cl. No. 1.10.6.13 of TCC and Cl. No. 2.16.1 of GCC.
1.10.6.12	The work shall be executed under the usual conditions without affecting power plant construction and in conjunction with other operations and contracting agencies at site. The contractor and their personnel shall co-operate with the personnel of other agencies, co-ordinate their work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
1.10.6.13	If any item or equipment not covered but requires being erected/commissioned, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.
1.10.6.14	After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.

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1.10.6.15	Contractor shall, transport all materials to site and unload at site / working area, or pre-assembly yard for inspection and checking. All material handling equipment required shall be arranged by the contractor.
1.10.6.16	Contractor shall retain all T&P / Testing instrument / Material handling equipment etc., at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.
1.10.6.17	Contractor shall remove all scrap materials periodically generated from their working area in and around power station and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc., shall be returned to the BHEL stores / customer's stores by the contractor.
1.10.6.18	The scrap generated after executing the work shall be returned to BHEL earmarked area every week and the same shall be vetted by the Engineer-in-charge, to be produced along with the running bill.
1.10.6.19	The contractor at their cost shall arrange necessary security measures for adequate protection of their machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of their machinery equipment tools etc.,
1.10.6.20	The contractor shall ensure that their premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.
1.10.6.21	The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for erection agreed will be subject to the condition that contractor's work is not hampered by the agencies.
1.10.6.22	All the surplus, damaged, unused materials, package materials, containers, special transporting frames, gunny bags etc. shall be returned to the BHEL stores / customer's stores by the contractor.
1.10.6.23	If required by BHEL, the contractor shall change the sequence of their operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

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1.10.6.24	Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.
1.10.6.25	Contractor has to work in close co-ordination with other erection agencies at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less/more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.
1.10.6.26	The contractor must obtain the signature and permission of the security personnel of the customer for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside.
1.10.6.27	The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe/tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange themselves all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.
1.10.6.28	The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess draws at the rate prescribed by manufacturing units.
1.10.6.29	No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
1.10.6.30	Contractors shall ensure that all their Staff/Employees are exposed to periodical training program conducted by qualified agencies/ personnel on ISO 9001 /2015 Standards.
1.10.6.31	For other agencies, such as piping, Boiler, ESP, TG, Instrumentation, insulation etc., to commence their work from/on the equipment's coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence/continue the work so as to keep the overall project schedule.
1.10.6.32	The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.
1.10.6.33	For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum kW demand.

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1.10.6.34	On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at their cost. In the event of their failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.
1.10.6.35	Prior to erection of any components inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.
1.10.6.36	All the equipment /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.
1.10.6.37	It is the responsibility of the contractor to do the alignment, checking, etc., if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.
1.10.6.38	No temporary supports shall be welded on the pressure parts of piping. Welding of temporary supports, cleats, etc. on the boiler columns shall be avoided. In case of absolute necessity contractor shall take prior approval from BHEL Engineer. Further, any cutting or alternation of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer.
1.10.6.39	In electrical MCC's the fixed and moving contacts in contactors & Copper strips shall be removed and kept in safe custody. The same shall be re-erected during commissioning of the system.
1.10.6.40	Whenever cable glands are supplied along with MCC'/JB's/ PB's/etc. they shall be removed and kept in safe custody. The same shall be re-erected during cable termination.
1.10.6.41	Permanent nomenclature/identification on LPBS/Junction boxes/Local Motor Starter boxes/AC Fuse DB/DC Fuse DB/Heater JB/Control panel, LT panel & individual feeders, SP Bus duct, heater JB, Transformers are to be done by the contractor as per the requirement decided BHEL Engineer at site.
1.10.6.42	All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there is no extra cost in this regard.
1.10.7.0	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.

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1.10.8.0	SITE INSPECTION
1.10.8.1	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.
1.10.8.2	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.
1.10.8.3	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.
1.10.8.4	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.
1.10.9.0	MANPOWER REQUIREMENT
1.10.9.1	Manpower requirement for Erection and Commissioning shall be as follows: a. There shall be a Resident manager as Site In Charge at site, under whom there shall be sufficient area engineers who shall take care of the erection activities. b. Resident Engineer should have a minimum qualification of Electrical/Electronics/C&I Engineering Degree with minimum 5 years' experience or Diploma in Electrical/Electronics/C&I Engineering with minimum 10 years of experience in Thermal Power Station. c. Area Engineer should have minimum qualification of Diploma in Engineering or any graduate with minimum 3 years of experience in Thermal Power Station.

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	d. Supervisor should have a minimum qualification of Diploma in Electrical/Electronics/C&I engineering or any graduate with minimum 5 years of experience in Thermal Power Station. e. Lab Technicians should have 2 years experience in Thermal Power Stations. f. Contractor should have one Store Keeper, one Transport Supervisor for the safe transportation of materials. g. Planning / safety Engineers should be available and they should have experience in construction field especially in power plant. h. Dedicated commissioning engineer should be deployed for commissioning of the equipment.
1.10.9.2	There shall be three separate Erection In-charges, each for Boiler, TG Station C&I. They shall work independently with required manpower, T&P etc., including storage facilities. Each Erection In-charge shall have minimum two erection engineers with adequate Supervisors and Technicians.
1.10.9.3	There shall be separate engineers for Planning, Safety and Quality.
1.10.9.4	Planning/Safety Engineers should have experience in construction field especially in power plant.
1.10.9.5	Each area engineer shall be provided with minimum four (04) supervisors and adequate number of Technicians / electricians and other erection staff and T&P etc. The testing Engineers / supervisors / electricians shall be identified separately for each package and the minimum requirement shall be as indicated in previous Clause. Besides, there shall be separate engineers for Planning, Safety and Quality.
1.10.9.6	The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor.
1.10.9.7	The testing Engineers/supervisors/electricians shall be identified separately for each package as per the site requirement.
1.10.9.8	The Site in charge shall be provided with PCs and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities will not be an excuse for extension of completion date.
1.10.9.9	All instructions from BHEL / Customer will be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name their authorized representative prior to or immediately on commencement of operations at site.
1.10.9.10	The Site In charge shall be present at site during all normal working hours and their contact address after normal working hours shall be made available to

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	BHEL so that if any emergency arises, the presence of the contractor's site Representative at site can be called for.
1.10.9.11	The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed suffering delay on this account.
1.10.9.12	The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of their duties the contractor shall remove them from site as directed by Site Engineer.
1.10.9.13	The contractor shall ensure that all their supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the contractor's personnel shall be brought to the attention of the contractor's site representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required by the Engineer-in-Charge.
1.10.9.13	The contractor shall ensure that replacement for such persons removed from site is provided immediately and the work is not allowed to suffer delay on that account.
1.10.10.0	DOCUMENTATION
1.10.10.1	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.
1.10.10.2	The following information shall be furnished by the bidder after testing and inspection: f. Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by customer's representative also, wherever called for as per field quality plan. g. As built drawings: After successful completion, testing and commissioning of installation work, Purchaser's drawings / documents shall be updated in line with the actual work carried out and as built drawings / documents shall be submitted by the contractor as agreed for the project.

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VOLUME-IA PART –I CHAPTER –XI

FOUNDATIONS AND GROUTING

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

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

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

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

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

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

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

1.12.1.0	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.
1.12.2.0	STORAGE
1.12.2.1	Materials shall be stacked neatly, preserved and stored in the contractor's shed/ work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area/ site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.
1.12.2.2	The equipment should be preferably in its original package and should not be unpacked until it absolutely necessary for its installation. The equipment should be best protected in its cases. It should be arranged away from walls.
1.12.2.3	The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damp, sinking into ground and to circulate air under the stored equipment. This will also help in lifting the packing with fork lift truck.

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1.12.2.4	Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced when decolonization takes place or regenerated. BHEL shall supply the material and contractor shall replace.
1.12.2.5	Due care should be taken to ensure that the equipment is not exposed to fumes gases etc. which can affect electrical contacts of relays and terminal boards.
1.12.2.6	The storage room and the equipment should be checked at regular interval of three months to ensure protection from termites, mound growth, condensation of water etc. which can damage the equipment.
1.12.2.7	Contractor shall keep BHEL informed about such problem and try to rectify the problem at their risk and cost.
1.12.2.8	All the instrument, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to site.
1.12.2.9	Packing material shall be retained if the cubicle to be repacked after inspection
1.12.2.10	The loose items supplied for the main equipment falls into various categories like tools, modules, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, PCs, monitors, cable glands, cable ducts, frames etc. are to be categorized and stored separately with proper identification.
1.12.2.11	Sub-Assemblies: a. All sub-assemblies should be kept in a separate place where it is easily accessible. b. Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should also be kept along with it. c. Sub-assemblies should not be stacked one above the other.
1.12.2.12	Loose items (wherever applicable): The loose items supplied for the main equipment falls into various categories like tools, modules, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, PCs, monitors, cable glands, cable ducts, frames are to be categorized and stored separately.
1.12.2.13	Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.
1.12.2.14	Sometimes it may become necessary for the contractor to handle certain unrequired components at Customer's / BHEL's stores in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.
1.12.2.15	The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site.

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1.12.2.16	Contractor has to arrange required fire resistant tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.
1.12.2.17	The contractor shall take delivery of item, materials and consumables from the storage yard / stores / sheds of BHEL / customer which are within a radius of 5 kms, after getting approval of engineer / customer in the prescribed indent forms of BHEL / customer. He shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to them till they are fully erected, tested and commissioned.
1.12.2.18	Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipment from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators, Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.
1.12.2.19	The equipment / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

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

1.13.0.0	THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING: (All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.) It is not the intent to specify herein all details of material. Any item related to this work, not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
1.13.1.0	DETAILED SCOPE OF C&I WORK
1.13.1.1	The scope of work for C&I items like Instruments, Panels, Hardware etc. covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, preassembly, calibration, checking, erection, testing, loop checking & commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, ferrules, lugs (specific sizes), specific types of fasteners, paints and consumables. deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipments, Testing instruments (excepting proprietary type instruments), returning of un-used materials / items to stores are also covered in the scope of work.
1.13.2.0	SCOPE OF WORK FOR C&I PANELS / CONTROL DESK:
1.13.2.1	The different types of Microprocessor based panels like VALMET DCS / PLC Panels, Instrument Panels, unit control desk etc. are covered in the scope of work for erection and commissioning.
1.13.2.2	The unit rate quoted for Installation of control panels shall include fixing of anti-vibration pads, levelling and alignment, welding, grouting, drilling of bottom gland plates for cable entry as required, closing control panels bottoms with suitable flame proof compounds wherever required and checking of internal wiring, instruments, components etc. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels except the Instruments identified in the BOQ.
1.13.2.3	Panels are normally supplied in suite of one / two / three/ four cubicles with bottom base frame and these panels are to be mounted on separate site fabricated base frames as per site condition. The base frames to be properly grouted to the concrete floor or to be TIG welded to the embedded insert plates. The structural steel material for the above will be supplied by BHEL. For fabrication and erection of frame, unit rate shall be paid as quoted in rate schedule, on tonnage basis.
1.13.2.4	For panels to be mounted on trenches, if any channel supports are required, the same shall be provided across the cable trenches over which the base frames of the panels shall be mounted. Similarly for the panels to be mounted

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

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	length of the panel. Variations in depth, height or weight of the panel shall not be considered for payment.
1.13.2.13	UPS, AC & DC DB AND OTHER ELECTRICAL CONTROL PANELS: The erection & commissioning scope of above panels will be in line with clauses above in 1.13.2.0
1.13.3.0	SCOPE OF WORK OF DCS PACKAGE / HMI/STATION LAN/PADO SYSTEM / SCADA etc WITH RELATED INSTRUMENTATION:
1.13.3.1	BHEL will supply sophisticated VALMET-DNA DCS system. The tentative details of are furnished in the BOQ.
1.13.3.2	The scope of DCS system includes erection of sophisticated microprocessor based systems, Valmet DNA control panels, I/O panels, Ethernet switching panels, Network Enclosure cabinets, CPU, Engineers workstations, operator workstations, CRTs, server, printers, portable UPS power supply, furniture and interconnecting cables like Ethernet/Fibreoptic etc.
1.13.3.3	The scope of work for DCS Panels will generally be in line with that for C&I Panels as detailed in Clause 1.13.2.0
1.13.3.4	Unit rate quoted for DCS equipment shall cover installation & integration of all the above said equipment and providing necessary commissioning assistance. No separate unit rate applicable for installation of loose items/ modules/ components or accessories including furniture etc, which is not explicitly mentioned in the BOQ, but comes as part of the system.
1.13.3.5	Laying and termination of all cables including Ethernet and fibre optic cables as detailed in the scope of work for cabling. Splicing/Termination of fibre optic cables is included in the scope of this contract.
1.13.3.6	If any underground C&I works for firefighting systems the earth excavation and earth filling is in the scope of civil.
1.13.4.0	SCOPE OF WORKS FOR UPS, BATTERY AND BATTERY CHARGER:
	GENERAL
1.13.4.1	The charger and batteries are of heavy duty type, capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden stands. Tentative details are given in the BOM.
1.13.4.2	BHEL will provide vendor's technical support for commissioning of Battery and Battery charger/ UPS. The contractor shall carry out the works as per instructions of BHEL/ Vendor Engineer.
1.13.4.3	Lump sum price shall be quoted for Erection and commissioning of Battery. No additional payment shall be made for any variation in the number of cells. The rate quoted for erection of battery will include the following works.
1.13.4.4	Collecting the batteries and all the accessories like cable connectors, inter cell connectors, equalizing connectors, rack insulators, fuse box, loop cables etc. from stores and assembling on the racks and fixing all loose supplied items as per drawings.
1.13.4.5	Filling the individual cells with Acid/alkali – as applicable.

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1.13.4.6	Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.
1.13.4.7	Arranging manpower in shift during battery charging and discharging cycles that may be carried out round the clock as per the code of practice, and conducting other routine tests as per IS under the supervision of BHEL Engineer/Vendor Engineer.
1.13.4.8	Modifications or changes if any for the loose supplied items or any minor changes in wiring.
1.13.4.9	Arranging necessary tools, T&P, Testing equipment required for erection and commissioning of the battery.
1.13.4.10	For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.
1.13.4.11	SCOPE OF WORK FOR BATTERY CHARGER PANELS: The scope of work will be in line with scope of work for electrical control panels, as detailed under CI.No. 1.13.2.0 above.
1.13.5.0	SCOPE OF WORK FOR INSTRUMENTS:
1.13.5.1	The type of instruments to be erected and commissioned shall be detailed below: a. Panel mounted Instruments like indicators, recorder, electronic modules etc. b. All types of transmitters like temperature, pressure, flow, level and position feedback transmitters etc. c. Local mounted pressure gauges, DP gauges, thermocouples, RTDs, temperature gauges, temperature switches, pressure switches, DP switches, flow switches and limit switches and flow indicator level switches etc. d. Air filter regulator sets, Air lock off valve, Power cylinders etc. e. Panel/ Control desk mounted Instruments like indicators, recorder, console and electronic modules etc. f. I/P converters and local controllers. g. Special instruments like vibration sensors, proximity sensors, electronic water level indicator, Steam and water analysis system (SWAS), Gas analyser, Coal Flow Monitor, PC based instruments etc. h. Pneumatic operated control valves, trip valves, solenoid valves, and electrically operated valves. (commissioning only).
1.13.5.2	Prior to installation, all the Instruments (local & remote), I/P converters, etc. shall be calibrated. Similarly, the healthiness of RTDs and thermocouples, limit switches, flow switches, level switches, solenoid valves, air filter regulator, purge meters, etc. shall be checked for proper operation.
1.13.5.3	Unit rate quoted for each instrument shall include calibration, installation, loop checking, commissioning and troubleshooting until satisfactory performance as per operational and system requirement and maintenance till the end of contract period or trial operation whichever is earlier. In case any instrument requires recalibration to achieve the expected performance, the same shall be

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	carried out at no extra cost. If any re-calibration or replacement of instruments and rechecking of cable termination is found necessary during commissioning, the same shall be done at no extra cost. The unit rate shall also cover marking Tag numbers of instruments or Racks, either by paint or a separate tag plate as per BHEL Engineer's directive.
1.13.5.4	Unit rates have been asked item-wise for instruments, gauges, switches, indicators, recorders etc. as indicated in BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items of work of the rate schedule.
1.13.5.5	Unit rate quoted for erection of pressure/ differential pressure transmitters, gauges, switches, shall include fixing the instruments on the racks / supports along with manifolds, and associated fittings and clamps.
1.13.5.6	Unit rate quoted for Temperature transmitters, I/P converters, Air filter/ Air lock off valves, Purge meters, Rotameters, position transmitter, probes etc shall include fixing the instruments on the racks / supports along with associated fittings and clamps.
1.13.5.7	Unit rate quoted for control room mounted instruments shall cover mounting of instruments on panels / desk wiring, minor grinding on the cut out of panels for proper fixing.
1.13.5.8	Unit rate quoted for erection of Casing temperature thermocouple of turbine/ metal temperature thermocouple (MTM) shall cover laying, dressing and clamping, supply and fixing of tag plates, etc. Welding of MTM pads shall be carried out by mechanical contractor. Necessary tray supports for routing of MTM thermocouples shall be erected as part of tray erection covered in the tender. Proper care shall be taken during cleaning the crevices where MTM Thermocouples are inserted.
1.13.5.9	Unit rate quoted for erection and checking of thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.
1.13.5.10	Unit rate quoted for erection and checking of temperature switches, gauges, thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells.
1.13.5.11	If any instrument is to be relocated for reasons not attributable to the contractor, but required for satisfactory performance, the same shall be carried out on extra works basis.
1.13.5.12	Level switches supplied shall be of different types- float type or fixed contact type (Electronic type). The scope of work for float type Level switches shall include fixing of switches on float chambers and fixing of float chambers on stand pipe, providing supports wherever required etc. The scope of work for Electronic type Level switches includes fixing of Electrode standpipe, Electrodes, Electronic unit, integration of all loose supplied items etc Any minor modification require to match Float chamber / Electrode standpipe with

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	tapping point same shall be carried out at no extra cost. Uniform unit rate shall be quoted for Erection and commissioning of various types of level switches, irrespective of their type.
1.13.5.13	The unit rate quoted for erection and commissioning of Electronic type Level switches includes fixing of Electrode standpipe, Electrodes, Electronic unit, any minor modification required to match Float chamber/ Electrode standpipe with tapping point, integration of all loose supplied items etc.
1.13.5.14	Unit rate quoted for erection / commissioning of special instruments like, Flame scanner, H.E.A Igniters systems, Vibration monitoring System, Smart wall blowers, Large video screen, Sonic Tube Leak Detection system, Automatic leakage controller for air preheater, SWAS, Flue Gas analyzers, Station LAN / HMI plant management system, PC based instruments, C&I lab, EPABX, Wireless communication, Plant security system, Hart management system, UPS with battery and charger, GPS clock system, Graphical interphase system, Video conference network as per configuration, operator training simulator, computer furniture, etc. shall include installation of all loose items which are not explicitly mentioned, but comes as part of the system, integration of total system and commissioning. Lump sum rate shall be quoted as mentioned in the BOQ. No separate rate shall be payable for loose items including furniture. The quantity of loose supplied items is approximate only. No proportional rate will be applicable for any variation in quantity or for any additional items supplied as part of equipment.
1.13.5.15	If any surface finishing / tapping is required to fix the sensors for Vibration Monitoring System, the same shall be arranged by the contractor at no extra cost.
1.13.5.16	Some of the Flue Gas Analysers are to be installed at Chimney 65 Mtrs as indicated in BOQ. For the erection of associated hardware for these analysers, like cables, trays, GI pipe etc. that are to be routed from the analyser panels at 65 Mtrs of Chimney to zero meter level, payment will be made at twice the unit rate quoted against each item.
1.13.5.17	For Coal Bunker level monitor supply, fixing / erection of the sensors onto legs of Bunkers is in the scope of customer. However, the contractor shall provide necessary approach platforms with ladders and any other assistance for erection of these sensors.
1.13.5.18	Canopy shall be provided for field-mounted instruments as per site requirements. Necessary materials like MS Plate shall be provided by BHEL. Rate for fabrication and installation of canopy shall be on tonnage basis.
1.13.5.19	Temporary protection by thermocol, polythene sheet, GI sheets shall be provided by the contractor for safe guarding the instruments against damages. The protective materials shall be supplied by the contractor at no extra cost.
1.13.5.20	In case the Instruments are mounted and supplied along with main equipment and the BOQ calls for Erection & Commissioning, the contractor shall carry

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	out removal, calibration, re-fixing and commissioning of same. Payment shall be made only for removal, calibration, re-fixing and commissioning, in line with rate quoted for removal, calibration and re-fixing of Instrument of similar type.
1.13.5.21	In case the Instruments are supplied as loose items, and the BOQ calls for removal, calibration, re-fixing and commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made only for Erection and commissioning in line with rate quoted for Erection and Commissioning of Instruments of similar type.
1.13.5.22	The scope of work for panels for TSS System, Sonic Tube Leak Detection System, Furnace Flame Viewing System, Master Clock System, Siemens core turbine panel etc. will be in line with the scope of work of C&I panels covered under clause above in 1.13.2.0
1.13.6.0	SCOPE OF WORK FOR IMPULSE PIPES:
1.13.6.1	Different types of impulse pipes, like alloy steel, carbon steel, stainless steel of different sizes and thickness shall be supplied with suitable fittings like coupling, sockets, root valves, drain valves, manifold, condensing pots, syphons, tees, bends, nut and tail piece.
1.13.6.2	Unit rate quoted for impulse piping shall include site routing using reducers (at root valve) unions, connector Nuts and tail pieces, sockets, nipples, equal tees, couplings, condensing pots, siphons, root valves, isolation valves cold bending, tig / arc welding. etc., fixing of manifolds and supporting with suitable fixtures and 'U' clamps and painting as per BHEL specification and site engineer's instructions. No separate rate shall be paid for the Impulse pipe fittings. The unit rate also includes supply of U clamps, fasteners, paints, etc. For impulse pipe support materials viz. Angles/ Channels, the rate shall be paid on tonnage basis. The above support materials shall be supplied by BHEL. For scope of painting, please refer Scope of Painting clause. Welding of impulse pipe for High Pressure Lines shall be carried out by High Pressure welder. Suitable root valves will be provided by BHEL on the tapping point wherever required
1.13.6.3	TIG-welding sets, welding transformer/generator rectifier, Hydraulic bending machines, DPT kits, Hydraulic testing pumps required for pressure testing of impulse pipes shall be arranged by the contractor. Similarly, consumables such as welding electrodes, gas, Tungsten rods, filler wire etc., shall be arranged by the contractor within the quoted rate.
1.13.6.4	For longer route lengths of impulse pipes, the contractor shall provide Tag numbers at appropriate locations as directed by BHEL site engineer.
1.13.6.5	Hydraulic test shall be conducted for all impulse pipes after completion of erection as per site engineer's directive, as part of the work.
1.13.6.6	The contractor shall obtain necessary approval for welding electrodes, filler wire from BHEL welding engineer at site.

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1.13.6.7	Impulse pipes Welder shall undergo test and get approval from BHEL welding engineer according to the nature of welding.
1.13.7.0	SCOPE OF WORK FOR PRE-FABRICATED/ SEMI-FABRICATED LIR/ LIE/ GAUGE BOARDS CABLES TERMINATION
1.13.7.1	If the frame or rack is supplied as a pre-fabricated item like LIR, same shall be erected, grouted and painted as per site requirement.
1.13.7.2	If any frame or support or rack supplied as semi fabricated item, same shall be assembled at site either by welding or bolting and erected, grouted and painted as per site requirement.
1.13.7.3	Unit rate quoted for such pre-fabricated /semi fabricated items like LIE/LIR and enclosure shall be on Number basis. Unit rate shall cover installation, grouting, painting and supply of nuts, bolts, anchor fasteners, grouting materials such as cement, sand etc as required. Unit rate shall also include full painting of impulse line fitted and supplied along with LIR/LIE/LGB.
1.13.7.4	Wherever LIR/LGB/LIE are supplied with instruments mounted on them, the rate quoted for LIR/LGB/LIE shall include calibration of all the instruments mounted on them as detailed in the BOQ. However if the instruments supplied as loose items, the instruments shall be calibrated and mounted on the LIR/LGB/LIE and separate calibration/erection /commissioning charges shall be applicable in line with other instruments erection.
1.13.8.0	SCOPE OF WORK FOR COPPER/STAINLESS STEEL TUBES:
1.13.8.1	Different sizes of copper tubes of different thickness with or without PVC coating shall be supplied in standard lengths of 15 meter Coils and Stainless Steel tube shall be supplied in standard length of 6meter. The connectors and tees will be of brass / Stainless Steel of different sizes as per site requirement.
1.13.8.2	The unit rate quoted on meter basis shall cover site routing, bending, providing supports, fixing of connectors, unions, valves, tees, etc. and connecting to the instrument air line instruments. The unit rate shall also include providing tag plates on instruments / power cylinders.
1.13.8.3	If copper / Stainless Steel tube length is more than half meter, suitable support shall be provided either by angle or trays. Protective angles to be used for copper tube routing. The support materials shall be supplied by BHEL. For fabrication and installation of steel supports and frames, the rate shall be as quoted in BOQ for fabrication and installation of steel Tonnage basis.
1.13.8.4	Copper / Stainless Steel tubes shall be clamped with suitable clamping materials. Supply of suitable Aluminium clamps and tag plates are under contractor's scope. The unit rate quoted for laying of copper tube shall cover the supply of clamping materials also. For SADC system copper tube, tag plates shall be provided near instruments, Tees and Power cylinders. Leak test shall be carried out after completion of tubing works as per guidelines.
1.13.9.0	SCOPE OF WORK FOR INSTRUMENT AIR LINES (GI PIPES):

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1.13.9.1	Different type of GI pipes of different thickness class shall be supplied along with GI fitting accessories like union, coupling, tee, reducers, elbow, valves, etc.
1.13.9.2	Unit rates on length basis for erection of instrument air lines includes site routing, providing supports, fixing "U" clamps, fixing of loose supplied GI accessories mentioned as above as per the drawings, providing fresh threading as required for jointing with unions, valves and all type of other fittings as required in the system. Unit rate also shall include supply of U clamps, Teflon tapes and bolts, etc.
1.13.9.3	Teflon tapes shall be used for tightening all the joints. No bending, welding etc. is allowed. No separate rate shall be paid for erection of GI fittings / accessories and U clamps.
1.13.9.4	After installation of instrument airlines, the line shall be blown and leak test shall be conducted for all the joints as per the guidelines given elsewhere in this tender.
1.13.10.0	SCOPE OF WORK OF ELECTRIC & PNEUMATIC ACTUATORS:
1.13.10.1	Different types of pneumatic actuators like regulating type, on-off type, of different stroke length shall be supplied. Some of them may be fitted and supplied with main equipment.
1.13.10.2	The unit rate quoted for erection & commissioning scope of electrical and pneumatic actuators includes fabrication and installation of base frame, modification of linkage mechanism wherever required and connecting the same with driven equipment, fixing of all accessories like air sets, Solenoid valves, air lock off valves, limit switches, if supplied loose item as part of power cylinders, replacing the damaged copper tubes or any other accessories like gauges, solenoid valves, limit switches, etc. connecting to air line, and adjusting the stroke length. No separate rate shall be paid for the above works. For all pneumatic and electrical actuators, the necessary Linkage Mechanism shall be supplied by BHEL as part of actuators. No separate rate shall be paid for erection of linkage mechanism. For fabrication and erection of steel supports and frames, the rate shall be paid on Tonnage basis.
1.13.10.3	The link rods have to be adjusted to suit the opening and closing position. This adjustment has to be repeated number of times till proper operation is obtained. If BHEL site engineer desires to remove the accessories like position transmitters, air locks, positioners, limit switches, solenoids etc. prior to erection either at BHEL stores or at site to avoid damages/pilferage, keep in safe custody and remount the same prior to commissioning, this shall be part of scope of work for power cylinders.
1.13.10.4	For calibration of any Pneumatic Actuator at field, temporary air supply if required shall be arranged by the contractor.
1.13.10.5	In case the power cylinder is supplied in assembled condition along with main equipment and the BOQ calls for Erection & Commissioning of the same,

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	payment shall be made only for commissioning, in line with rate quoted for commissioning of pneumatic power cylinder of similar type.
1.13.10.6	In case the power cylinder is supplied as loose item, and the BOQ calls only for commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made in line with rate quoted for Erection and Commissioning of power cylinder of similar type.
1.13.10.7	Erection and Commissioning of MCCs and laying of power cables to bi-directional electrical actuators shall be done by other agency. The C&I Contractor shall provide necessary support for checking the remote operation of Electric actuators and loop checking of command and feedback signals from DCS to the actuator. The Contractor shall co-ordinate with the other agencies to ensure that all feedback and command signals and settings are made available for bi-directional.
1.13.11.0	SCOPE OF WORK FOR CABLES:
1.13.11.1	BHEL will supply LT, 1.1 kV, armoured/ unarmoured, Copper PVC FRLS insulation, Power, Control and Instrumentation cables of different sizes. The special cables supplied shall be Compensating cable, Ethernet cables and Fibre-optic cable of different sizes and type.
1.13.11.2	The cables covered in the BOQ may be appearing either in BHEL's C&I cable schedule or in BHEL's Electrical cable schedule. The contractor shall lay and terminate all the cables covered in the BOQ, as per directive of BHEL Engineers.
1.13.11.3	The scope of work includes laying & termination of cables, fixing of glands, ferrules, tag plates with necessary numbering and dressing of cable, as per BHEL specification and BHEL engineer's instructions. A composite rate covering laying and termination shall be applicable for cables, except for higher size cables. Separate rate will be applicable for termination of higher size cables and the same will be indicated specifically in the Rate Schedule / price bid / BOQ.
1.13.11.4	Unit rate quoted for cable shall cover laying, termination, drilling of holes on the gland plates of the panels/JB or Enlargement of cable entry holes by tapping or any modification required, fixing of cable glands, fixing of glands, ferrules, termination and providing tag plates and dressing.
1.13.11.5	Unit rates quoted for cabling shall also include supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 2.5 sq.mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed elsewhere in this tender.
1.13.11.6	Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, underground, cable shafts etc.
1.13.11.7	Ethernet cables and Fibre optic cables shall be isolated from other cables and laid in a separate cable tray as directed by site Engineer. Wherever required

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	I/O Box shall be installed for Ethernet cable termination and Punch Down crimping tools shall be used for Ethernet cable termination.
1.13.11.8	The scope of work for Fibre Optic cable shall be laying and termination including fixing of fibre optic components and termination kits LIU,space splits cabinets, couplers, grounding etc. Wherever required, the Fibre optic cable shall be laid through HDPE Conduit.
1.13.11.9	The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. No separate rate shall be paid for cable terminations. For cable joining, if any, separate rate shall be considered on extra works basis.
1.13.11.10	The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if any other agency laid cables of lesser quantity for which no separate trays have been allotted, the contractor shall do clamping along with the cables.
1.13.11.11	Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.
1.13.11.12	During testing and commissioning, if the equipment on which the cables are terminated (including electrical drives) is not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling. The contractor shall promptly depute their supervisor or technicians to assist the commissioning agencies to check the interconnecting cables at no extra cost.
1.13.11.13	Contractor shall carefully plan the cutting schedule for each cable drum in consultation with Engineer such that wastage is minimized and any resultant short lengths can be used where appropriate route lengths are available.
1.13.11.14	If the cables are to be laid on the angles or routed in conduit pipe as per site condition, the unit rate for erection of angles and conduit pipes shall be as per the rate quoted elsewhere in the tender.
1.13.11.15	Any fabrication required at site for cable support shall be carried out at the rate quoted for fabrication.
1.13.11.16	Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services any such adjustment shall be done with the approval of Engineer.
1.13.11.17	The approximate number of termination for the purpose of estimation to be assumed as follows: The average RUN length shall be considered as 150 metres. However, for 10% of the 2 pair and below, the average length shall be considered as 30 metres.
1.13.12.0	SCOPE OF CABLE TERMINATION:
1.13.12.1	Laying and termination of all cables including Ethernet, fibre optic cable is part of the scope.

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1.13.12.2	The scope of termination shall include termination of cables on various panels / JB's / Push buttons / equipment etc. including those installed by other agencies.
1.13.12.3	Re-termination, if required during testing/ commissioning shall be carried out without additional cost.
1.13.12.4	Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant, long enough to over pass conductor insulation and properly sized.
1.13.12.5	Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.
1.13.12.6	Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.
1.13.12.7	After cable terminations, the debris shall be removed then & there. Also refer Cl.No. 1.13.11.0 above.
1.13.13.0	SCOPE OF WORK FOR CABLE TRAYS/CONDUITS/FLEXIBLE CONDUITS/HOSE:
1.13.13.1	CABLE TRAYS: Scope of cable tray works covers erection of various sizes of perforated trays with accessories mostly for branch trays in Power House building. All type of cable trays including, standard trays accessories shall be supplied by BHEL. The scope of work for cable trays shall be as follows: a. Different Junction The unit rate for erection of trays shall be on meter basis. The unit rate quoted for erection of tray shall also include erection of all tray accessories such as elbow, cross, Tees, bends such as vertical and Horizontal, reducers, coupler plates/fixing plates, anchor bolts, fasteners etc. b. For routing of trays standard tray accessories supplied by BHEL shall be used. However if above standard tray accessories are not supplied, the same shall be fabricated and installed at no extra cost. c. If standard tray accessories like Tees, Reducers, Bends, cross etc. require any modification to suit the tray routing, the same shall be carried out at no extra cost. d. The unit rate quoted for trays shall also cover making of offsets by means of cutting standard tray sections and inserting suitable trays to match with the existing arrangement. e. Site fabrication / modification of trays or on tray accessories will be paid on extra work basis. f. The contractor shall quote a uniform rate on meter basis for erection of trays and Tray accessories like Tees, Reducers, Bends, cross etc. g. Tray covers are to be erected after completion of cable laying and no separate payment will be made for fixing these covers. GI strip clamps are to be used for fixing the tray covers.

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	h. Welded Joints of trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS 3043. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.
1.13.13.2	RIGID & FLEXIBLE CONDUITS: - Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe/flexible conduits supplied by BHEL shall be used. Unit rate shall be paid on running meter basis. - Unit quoted on meter basis for flexible conduit includes drilling of the holes on the plates, fixing of the end connectors, providing suitable supports and fixing tag marks wherever specified as required by BHEL. No separate payment will be made for fixing of end connectors. - Unit quoted on meter basis for GI rigid conduit includes supply of suitable clamps / fasteners / tag plates etc. - The scope of work includes drilling of holes on the plates, fixing of end connectors, providing suitable supports and fixing tag plates as required by BHEL. Supply of suitable clamps, fasteners and tag plates are covered in the unit rate.
1.13.13.3	SCOPE OF WORK FOR JUNCTION BOXES/CJCBs /PUSH BUTTON BOXES:
1.13.13.4	Different Junction Boxes/ Push Button boxes with gland plates shall be supplied by BHEL.
1.13.13.5	The unit rate quoted for erection of junction boxes/push button boxes shall cover the following also. - Providing necessary supports - Drilling of bottom gland plates for cable glands as required - Painting the tag Nos. or fixing a separate tag plate on junction boxes/push button boxes - Minor chipping, grouting as required for mounting the JB/PB - Supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button. - Closing all unused holes on the gland plates using grommet or any other suitable materials. - Any modification like replacement of terminals, enlarging gland holes etc. that may be required to accommodate power cables.
1.13.13.6	All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.
1.13.13.7	For CJCBs/ RJCBs, the rate for Junction Boxes similar size, as per Rate Schedule, will be applicable.
1.13.13.8	For fabrication and fixing of supports/Frame, rate shall be paid on tonnage basis.

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1.13.14.0	SCOPE OF WORK FOR FABRICATION & ERECTION OF STEEL MATERIALS:
1.13.14.1	Scope of steel fabrication and installation covers, fabrication and installation of various type of supports for cable tray, instruments, impulse pipes, GI pipes, support angles for copper tubing, mounting frames for JB, Control Box/Panel, local PB Stations, canopy for local instruments and local instrument rack etc. wherever required.
1.13.14.2	The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL. Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers.
1.13.14.3	Immediately after fabrication, primer shall be applied to prevent corrosion. The installation shall be carried out only after applying the primer as detailed in painting clause.
1.13.14.4	All fabricated steel materials shall be painted as detailed in the scope of painting.
1.13.14.5	A composite rate shall be quoted for fabrication and installation of steel, on tonnage basis. The above rate shall include supply of paints and painting, grouting and grouting material as required.
1.13.15.0	SCOPE OF EARTHING:
1.13.15.1	The scope of earthing covered in this contract is above ground earthing i.e equipment earthing. Scope of earthing covers earthing of field Instruments, JBs, Branch trays, LIR/LIE, JB, Push Button boxes etc. All DCS and its accessories, PLC/Instrumentation panels/systems etc, shall be earthed to a separate Electronic earth grid.
1.13.15.2	Different type of earthing materials shall be supplied and same shall be erected as per site requirement.
1.13.15.3	The scope of work shall include supply of fasteners, lugs, minor civil works etc.
1.13.15.4	All connections from the equipment to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the contractor at site.
1.13.15.5	The unit rate shall be quoted for earthing on metre basis. The rate shall cover supply of fasteners, lugs, minor civil works, painting the welded joint etc.
1.13.16.0	SCOPE OF CALIBRATION:
1.13.16.1	The contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, recorders, Indicators etc. that will be supplied along with equipments mounted in or in loose.
1.13.16.2	Contractor has to calibrate all the instruments covered in their scope at site with their own calibration and testing equipment's under the supervision of BHEL / Customer Engineers and maintain the calibration records as per the BHEL prescribed format / relevant FQP formats.

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1.13.16.3	All testing Instruments / Equipment deployed for calibration shall be calibrated before taking into service. All testing instruments shall have calibration certificate issued by recognized /accredited agencies. A copy of calibration certificate shall be submitted to the engineer for their verification and approval.
1.13.16.4	BHEL shall provide vendor supports for proprietary type of microprocessor – based instruments, protective relays, which requires software loading and programming etc. However overall responsibility lies with contractor and contractor shall provide all supports like manpower ,standard T&P, Instruments etc., for calibration and testing of above proprietary instruments.
1.13.16.5	If BHEL is unable to provide or arrange vendor support for proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by the outside agency shall be reimbursed by BHEL. However if above such calibrator is available with BHEL at site, the calibration shall be carried out by the contractor with in quoted rate.
1.13.17.0	MEASUREMENTS, WASTAGE & CUTTING ALLOWANCES:
1.13.17.1	For all payment purposes, measurement shall be made on the basis of the execution of drawings/physical measurements. Physical measurements shall be made by the contractor in the presence of the Engineer.
1.13.17.2	The measurement for cable, impulse pipes/tubes, GI pipe, conduits, flexible conduits, trays etc. shall be made on the basis of length actually laid.
1.13.17.3	All the surplus, scrap and serviceable materials, out of the quantity issued to the contractor shall be returned to BHEL in good condition and as directed by the engineer.
1.13.17.4	All materials returned to stores should carry an aluminium tag indicating the size and type. More than 5 metres length termed as serviceable material and shall be returned size wise and category wise to the owner's stores/yard. Cable of serviceable length being returned to the stores in drums shall have their free ends sealed and the balance lengths on the drum(s) shall be noted and certified by the Engineer-in-charge. This shall be applicable only for the purpose of accounting the cables issued for installation.
1.13.17.5	While carrying out material reconciliation with contractor, all the above points will be taken into account. All serviceable material returned by the contractor shall be deducted from the quantities issued for the respective sizes and categories and the balance quantity(ies) will be taken as the net quantity(ies) issued to the contractor. Material appropriation shall be done and allowable scrap quantity calculated as per wastage allowance specified below. Any scrap / wastage generated by the contractor in excess of the allowable percentage shall be charged at the rates decided by the Engineer whose decision shall be final and binding on the contractor.
1.13.17.6	For all site-fabricated steel items such as supports, racks, frames, Canopy etc. physical measurement shall be made and then converted to tonnage. For steel

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	material supplied to the contractor, all scrap shall be returned to BHEL stores with due accounting.															
1.13.17.7	Every month the contractor shall submit an account for all the materials issued to them by BHEL in the standard proforma prescribed for this purpose by the site in charge.															
1.13.17.8	The cable take off from drums shall be planned strategically such that jointing in the run of cables and wastage are avoided. For this purpose the exact route length between various equipment/panels as per the cable schedule shall be measured and the route length recorded before laying of the cables. Depending upon the route length the type of cable required for various destinations, the cable drums shall be suitably selected for cable laying. Jointing of cable, if any shall be approved by the BHEL engineer. All the cut pieces / bits of cables which are not used / unused shall be returned to the BHEL stores for accounting towards wastage. The cables damaged by the contractor shall have to be replaced by the contractor at their own cost.															
1.13.17.9	The erection contractor shall make every effort to minimize wastage during erection work. The wastage allowances as permissible for various items are indicated in the following table. Cutting and wastage allowance shall be computed on the lengths and weight of materials actually used, measured and accepted. In any case, the wastage shall not exceed the following limits. <table><tr><th>Sl.No.</th><th>Item</th><th>% wastage on issued quantity</th></tr><tr><td>01</td><td>Fabrication Steel</td><td>2</td></tr><tr><td>02</td><td>Each size of power cables</td><td>1</td></tr><tr><td>03</td><td>Each size of control / instrumentation cables</td><td>2</td></tr><tr><td>04</td><td>Impulse pipe / tubes / GI Pipes / Copper Tubes</td><td>1</td></tr></table> NOTE: 1. Salvageable scrap shall mean lengths of pipes, multicables, other cables etc., that can be used one time or other at a later date and normally they are recovered from the cut-pieces of tubes, pipes, multicore cables, cables etc. 2. Non - Salvageable scrap means the lengths of tubes, pipes, multicore cables, cables etc., and they are from cut-pieces of tubes, pipes, multicore cables, cables etc., that cannot be used at all one time or other.	Sl.No.	Item	% wastage on issued quantity	01	Fabrication Steel	2	02	Each size of power cables	1	03	Each size of control / instrumentation cables	2	04	Impulse pipe / tubes / GI Pipes / Copper Tubes	1
Sl.No.	Item	% wastage on issued quantity														
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03	Each size of control / instrumentation cables	2														
04	Impulse pipe / tubes / GI Pipes / Copper Tubes	1														

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VOLUME-IA PART – I CHAPTER – XIV

PROGRESS OF WORK

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

1.14.0.0	PROGRESS OF WORK
1.14.1.0	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.
1.14.2.0	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.
1.14.3.0	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.
1.14.4.0	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.
1.14.5.0	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.
1.14.6.0	Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise their work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.
1.14.7.0	The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out on each weld and maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any,

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	percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required.
1.14.8.0	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.
1.14.9.0	The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
1.14.10.0	The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
1.14.11.0	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.
1.14.12.0	The contractor to reflect actual progress achieved during the month and shall be submitted to BHEL, so that slippages can be observed and necessary action taken in order to ensure that the situation does not get out of control will update the construction schedule forming part of this contract each month.

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VOLUME-IA PART - I CHAPTER- XV

TESTING AND COMMISSIONING

TESTING, PRE-COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

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

1.15.1.0	The scope of commissioning works covers commissioning of all instruments covered in the BOQ including loop checking and establishing the operation of instruments / systems to meet plant commissioning / operation. The contractor shall be responsible for overall commissioning of all the instruments and systems covered in the BOQ.
1.15.2.0	SCOPE OF PRE-COMMISSIONING / COMMISSIONING AND POST COMMISSIONING WORKS:
	Scope of pre-commissioning / commissioning starts with the commissioning of various equipment erected by the contractor and making them available to commission various materials / systems and main power plant. The scope of work of various commissioning activities of the main plants is referred below: a. Trial run of various equipment b. Light up of boiler c. Boiler EDTA/chemical cleaning d. Boiler alkali boil out e. Turbine barring gear f. Steam blowing of piping g. Turbine rolling h. Safety valve floating i. First synchronization j. Heavy oil firing and synchronization k. Coal firing l. Trial Operation/Full Load The above activities, tests, trial runs may have to be repeated till satisfactory results are obtained and also to satisfy the requirements of customer / consultant / statutory authorities like boiler inspector, electrical inspector etc.
1.15.2.1	The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.
1.15.2.2	The pre-commissioning activities of the main power plant will start with energizing of startup power supply systems followed by trial run of various drives prior to light up of boiler. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by them to match with the various milestone activities /commissioning program of the project. All these works need specialized testing engineers,

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	supervisors including electricians in each area to co-ordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted for erection work. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractors Scope
1.15.2.3	The mobilization of testing team shall be planned in time and shall be undertaken round the clock. Contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost will be recovered from contractor.
1.15.2.4	After erection of various equipment prior to commissioning and after commissioning, protocols have to be made with BHEL / Customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers.
1.15.2.5	For electrical works, 415 volts and above, the contractor has to bring qualified electricians and the total work has to be certified by electrical license holder. The expenditures towards work certificate and all statutory requirements connected towards the high voltage system shall be borne by the contractor.
1.15.2.6	In case any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at their cost. During commissioning, any improvement rework / rectification / modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.
1.15.2.7	During commissioning activities and carrying out various tests, if any of the instruments has to be temporarily erected and commissioned to suit the commissioning activities, the contractor have to carry out the erection of the same. After completion of activities the temporary systems have to be removed and returned to stores and no extra rate shall be paid for this.
1.15.2.8	All the T&P instruments required for commissioning are to be arranged by the contractor. However, any special instruments, which are of proprietary nature, shall be arranged by BHEL.
1.15.2.9	It shall be the responsibility of the contractor to arrange and complete all the testing, pre-commissioning and commissioning activities for the particular equipment as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. All the above will be witnessed by the BHEL engineers and reports signed shortly. Contractor shall follow checklist of BHEL

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	and testing & commissioning activities shall be carried out in accordance with the checklist.																								
1.15.2.10	The scope of commissioning shall also cover the commissioning of the equipment / drives erected by the mechanical contractors. (as detailed in the BOQ)																								
1.15.2.11	The mobilization of testing team shall be planned in time and shall be undertaken round the clock. The contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost shall be recovered from contractor.																								
1.15.2.12	Prior to commissioning and after commissioning, protocols have to be made with BHEL / customer. The formats shall be given by BHEL and have to be printed by the contractor in adequate numbers. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractors Scope																								
1.15.2.13	Any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at their cost.																								
1.15.2.14	Commissioning Engineers also shall be identified separately for each package and the minimum requirement shall be as indicated below (Requirement given below is per Package). <table><tr><td></td><td>Boiler</td><td>TG</td><td>Station C&I</td><td>BOP and Misc</td><td>TOTAL</td></tr><tr><td>Engineer (C&I)</td><td>01 No.</td><td>01 No.</td><td>01 No.</td><td>01 No.</td><td>04 Nos.</td></tr><tr><td>Supervisor (C&I)</td><td>03 No.</td><td>03 No.</td><td>03 No.</td><td>03 No.</td><td>12 Nos.</td></tr><tr><td>Technician (C&I/Electrical)</td><td>08 No.</td><td>06 No.</td><td>08 No.</td><td>08 No.</td><td>30 Nos.</td></tr></table>		Boiler	TG	Station C&I	BOP and Misc	TOTAL	Engineer (C&I)	01 No.	01 No.	01 No.	01 No.	04 Nos.	Supervisor (C&I)	03 No.	03 No.	03 No.	03 No.	12 Nos.	Technician (C&I/Electrical)	08 No.	06 No.	08 No.	08 No.	30 Nos.
	Boiler	TG	Station C&I	BOP and Misc	TOTAL																				
Engineer (C&I)	01 No.	01 No.	01 No.	01 No.	04 Nos.																				
Supervisor (C&I)	03 No.	03 No.	03 No.	03 No.	12 Nos.																				
Technician (C&I/Electrical)	08 No.	06 No.	08 No.	08 No.	30 Nos.																				
1.15.2.15	The above commissioning group shall be identified at the Pre-commissioning and commissioning time. The above commissioning group shall have knowledge of various systems referred in the tender and also should have adequate experience.																								
1.15.2.16	The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor. Besides the above, there will be separate engineers for Planning, Safety and Quality. For all practical purposes, each of the above In-charges shall be provided with a PC and good communication facilities.																								
1.15.2.17	If the contractor fails to deploy the above Engineer / Supervisor / Technician at appropriate time of commissioning, BHEL Engineer will have the right to																								

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	withhold the payment towards commissioning activities as defined in terms of payment.
1.15.2.18	T& P / instruments required for testing are to be arranged by the contractor.
1.15.2.19	All commissioning / testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above shall be witnessed by BHEL engineer and the reports signed jointly.
1.15.2.20	The scope of commissioning assistance to be provided by the contractor shall cover the equipment / drives erected by the mechanical contractors as detailed in the BOQ.
1.15.2.21	Scope of commissioning of equipment erected by the mechanical contractor: a. The scope of commissioning assistance to be provided by the contractor will cover the equipment / drives erected by the mechanical contractors as detailed in the BOQ. b. The scope of work also includes collecting the replacement instruments / parts from BHEL / customer stores, stockyard etc. c. Separate group shall be identified for commissioning. The above group shall be available right from Trial run to full load operation including shift operation.
1.15.2.22	PNEUMATIC (ALL TYPES OF VALVES AND POWER CYLINDERS) a) Calibration and checking of instruments mounted on the actuators and setting stroke length of the actuator. b) Servicing of positioners, position transmitters, limit switches, solenoid valves, air lock-off valves, removing/replacement of defective components, copper tubes etc., if necessary. c) If the actuator is to be removed for attending to any mechanical problems, removing of copper tubes, cables etc. reconnecting and re-commissioning of the actuators is to be done. d) Testing and checking the remote / local operation in Auto as well as Manual mode. e) Fixing of instruments if supplied as loose items. f) Attending to any defects till the contract period.
1.15.2.23	FLOW METERS / SWITCHES a) Checking the calibration and servicing if required. b) Setting the alarm value c) Replacement of defective components if any

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1.15.2.24	LIMIT SWITCHES & LEVEL SWITCHES a) Checking the operation b) Replacing defective components if required
1.15.2.25	SOLENOID VALVES a) Checking the healthiness of coil b) Checking the operation c) Replacement of defective components if required.
1.15.2.26	TEMPERATURE ELEMENTS (MOTORS AND GENERATORS WINDING AND BEARING) a) Checking the healthiness b) Replacement of defective element (only for bearing)
1.15.2.27	DIRECT WATER LEVEL GAUGES (REMOTE & LOCAL) a) Checking the calibration b) Fixing of bulbs and extending Power supply c) Replacing defective components
1.15.2.28	INSTRUMENTS MOUNTED ON THE EQUIPMENTS / SKIDS / PANELS Scope of work covers removal, re-calibration, re-fixing, and re-termination of cables, checking the continuity, replacing any defective parts or replacing the total instrument, if required.
1.15.2.29	All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above will be witnessed by BHEL engineer and the reports signed jointly.
1.15.2.30	All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications. Specialized test equipment, if any, shall be provided by BHEL / its client free of hire charges. However contractor has to take proper care of the equipment issued to them.
1.15.2.31	All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at their cost.
1.15.2.32	It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any

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	other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.
1.15.2.33	It shall be specifically noted that the contractor and employees of the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers / customer officials. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers / supervisors.
1.15.2.34	In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at their cost. If any equipment / part is required to be inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.
1.15.2.35	Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.
1.15.2.36	After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary consumables, hand tools and supervision as part commissioning assistance till handing over of sets to customer.
1.15.2.37	The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.
1.15.2.38	The contractor shall carryout any other test not listed in the tender as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.
1.15.2.39	It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications including for trial operation, even if commissioning of equipment is delayed due to reasons not attributable to the contractor.

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VOLUME-IA PART-I CHAPTER-XVI PAINTING

1.16.0.0	PAINTING
1.16.1.0	FINAL PAINTING The scope of the work will comprise of but not limited to the following:
1.16.1.1	The scope of work shall also include supply and application of final painting of all the components, other equipment's etc., erected under the scope of this tender. The painting shall be as required and specified in the painting schedule for power plant equipment, structures, piping etc. which forms the part of this tender book.
1.16.1.2	The scope of painting generally includes painting of all steel items such as supports, racks, frames, canopy, LIE/LIR/LGB, impulse pipes, etc. carried out by the contractor. Painting shall be carried out for any bare copper tubes also.
1.16.1.3	The scope also includes supply of paints, primers, tools/consumables like brushes, rollers, emery papers, thinner etc., at no additional cost.
1.16.1.4	In the case of steel fabricated items, raw steel after fabrication has to be surface cleaned and subsequent painting to be carried out.
1.16.1.5	All the exposed metal parts of the equipment including bus ducts, transformers,, structures, etc., wherever applicable after installation unless otherwise specified the surface protected, are to be first painted with at least one coat of suitable primer and required number of finish coats as indicated in the Painting Specification which matches the shop primer paint used, after thoroughly cleaning the dust, rust, scales, grease oil, and other foreign materials by wire brushing scrapping and chemical cleaning and the same being inspected and approved by BHEL engineers for painting. Afterwards the above parts shall be finished with as per the instructions of BHEL/Customer official.
1.16.1.6	All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over.
1.16.1.7	Paint shall be applied by brushing or by spray painting as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimal.
1.16.1.8	Spray painting has to be carried out within the Quoted wherever required/asked for. Spray painting gun and compressed air arrangement has to be made by the contractor themselves.
1.16.1.9	Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.
1.16.1.10	Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted. Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.,

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1.16.1.11	The scope of painting includes application of colour bands, lettering the names of the systems equipment; tag Nos of valves, marking the directions of flow and other data required by BHEL within the quoted rate.
1.16.1.12	All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.
1.16.1.13	Finish coat paint, No of coat and DFT shall be as indicated in the painting specification enclosed in this tender / relevant BHEL document/ customer's specifications. The painting specification which is forming part of this tender as in TCC shall be used as guidelines to be followed.
1.16.1.14	The actual colour to be applied shall be approved by the customer before starting of actual painting work.
1.16.1.15	Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the BHEL / Customer approved agencies only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities.
1.16.1.16	No paint shall be applied when the surface temp is above 55 deg. Centigrade or below 10 deg. Centigrade, and when the humidity is greater than 90% to cause condensation on the surface or frost / foggy weather.
1.16.1.17	Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.
1.16.2.0	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

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	cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour. Besides above two coats of approved primer paint is to be applied on all the bare / unpainted surfaces. Touch up painting is generally required for trays, control panels.
1.16.2.3	All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.
1.16.2.4	Contractor shall carryout cleaning and preservation / touch up painting for the materials / equipment under this tender specification right from pre- assembly stage to till the equipment is cleared for final painting.
1.16.2.5	Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with touch up coat of red oxide primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.
1.16.2.6	Equipment / items/ components supplied during storage and handling, may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour.

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

SI No.: 1

OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME

The following clauses in Occupational Health, Safety & Environment Management / Quality Assurance Programme published in Chapter-IX of Special Conditions of Contract (Volume I Book-II) is revised as under.

Chapter IX Clause 9.1 is modified as below:

Contractor will comply with HSE (Health, Safety & Environment) requirements of BHEL as per the “HSE Plan for Site Operations by Subcontractor” (Document No. HSEP: 14 Rev 01) enclosed.

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VOLUME-IA PART – II CHAPTER 2 DATA SHEET

2.2.1.0	SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS
2.2.1.1	CLAMPS: A. Material type: Nylon Self-Locking ties Aluminium strips clamps as mentioned in Chapter-3 of Technical Conditions of Contract (Volume-IA Part-II in Book-I) B. Sizes: To meet the requirements mentioned in Chapter-3 of Technical Conditions of Contract (Volume-IA Part-II in Book-I)
2.2.1.2	FERRULES: As mentioned in Chapter-III of Technical Conditions of Contract (Volume-IA Part-I in Book-I)
2.2.1.3	TAGS: A. Material: Aluminium / Fibre / Stainless Steel B. Markings: Engraving / Embossing / Printing C. Size: As required
2.2.1.4	CABLE LUGS: Copper / Aluminium (Crimping Type)
2.2.1.5	CLAMP SPACING: A. Power Cables: Above 35 mm OD i) Horizontal Runs: Individually clamped at 3000 mm Interval (max) ii) Vertical Runs: Individually clamped 3000mm intervals (max) Up to 35 mm OD i) Horizontal Runs: Collectively clamped at 3000 mm intervals (max) ii) Vertical Runs: Collectively clamped at 2000 mm interval (max) B. Control Cables: i) Horizontal Runs: Collectively clamped at 3000 mm interval (max) ii) Vertical Runs: Collectively clamped at 3000 mm interval (max) C. Spacing for Cables supported along structure / ceiling i) Horizontal Runs: 750 mm (max) ii) Vertical Runs: 750 mm (max) iii) Spacing between cables: 30 mm (min) Note:

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	a. Supports shall also be proved at each bend. b. For any change in above spacing, prior approval of Engineer shall be taken.																
	CABLE TERMINATION: Type of Lugs a. Power Cables: Copper / Aluminium / Both crimping type b. Control Cables: Copper pin type, copper screw type, Direct termination c. Special Cables: Pin type, maxi-termi type																
2.2.1.6	Wastage Allowance: <table> <tr> <th><u>Material</u></th><th><u>Allowance permitted</u></th></tr> <tr> <td>Structural Steel:</td><td>2% (by weight)</td></tr> <tr> <td>Cable Tray:</td><td>2%</td></tr> <tr> <td>LT Cable:</td><td>1%</td></tr> <tr> <td>Control, Instrumentation & Special Cable:</td><td>2%</td></tr> <tr> <td>Fire Survival Cables:</td><td>1 %</td></tr> <tr> <td>Impulse Pipe/Tubes/GI Pipes/ Copper Tube:</td><td>1%</td></tr> <tr> <td>Earth flats:</td><td>2%</td></tr> </table>	<u>Material</u>	<u>Allowance permitted</u>	Structural Steel:	2% (by weight)	Cable Tray:	2%	LT Cable:	1%	Control, Instrumentation & Special Cable:	2%	Fire Survival Cables:	1 %	Impulse Pipe/Tubes/GI Pipes/ Copper Tube:	1%	Earth flats:	2%
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VOLUME-IA PART – II CHAPTER 3 GENERAL TECHNICAL REQUIREMENTS AND GUIDELINES FOR INSTALLATION, TESTING, COMMISSIONING AND SUPPLY ITEMS OF C&I PACKAGES

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

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

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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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

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2.3.9.0	Testing: a. On completion of pipeline, installation, the pipelines shall be hydraulic tested. Contractor shall arrange for hydraulic pump and standard gauges and conduct the test satisfactorily. b. The impulse lines shall be isolated from the instruments and tested at two times the maximum working pressures. The fall in pressure shall not be more than 1 kg/cm ² or 1% of the working pressure whichever is less, in 30 minutes and there shall be no leaks, at any of joints / welds, when isolated from source of press.
2.3.10.0	Guidelines for Installation of Pneumatic Line
2.3.10.1	Copper tubing shall be connected with Olive type of compression fittings.
2.3.10.2	When two or more lines run together, the joint in the adjacent alternate line shall be a offset.
2.3.10.3	In case of copper tubing, the single run copper tube may be supported with an angle. However, suitable trays shall be used for more than one tubing.
2.3.10.4	Multi-core copper tubing shall not to be bend less than 10 deg and D is the OD if the multi-core copper.
2.3.10.5	All air distribution, main and branch lines shall be galvanised internally as well as externally and the galvanized pipe, never, shall be braced or welded.
2.3.10.6	The joints shall be screwed with Teflon tapping wherever the pipes are to be removed frequently for cleaning and other purposes and suitable union fittings shall be used.
2.3.10.7	Care shall be taken while taking a branch pipe to see that the line is not taken from the lower part of the main line or main header in order to avoid entry of any drain or dust into the system.
2.3.10.8	Instrument airline should not be routed where severe vibration, high temperature exists and adequate space should be available for maintenance.
2.3.10.9	Care shall be taken when removing the PVC sheeting, while connecting the copper tube. The exposed portion after jointing shall not be excessive and also while removing PVC, the tube should not get damaged. Pipe cutters should not be used for cutting the copper tube, instead the specific copper tube cutter shall be used. Similarly, for bending copper tubes, specific copper tube bender should be used and the radius of the bending shall be more than 2.5 times of the OD of the copper tube.
2.3.10.10	While using the pipe cutter, care shall be taken to remove burr from the cutting side.
2.3.10.11	In locations where the copper tube is likely to be damaged from outside, the copper tube can be routed near a different pipe. While laying copper tube either inside angle or trays, the tube shall be supported at least at every one metre distance.
2.3.10.12	While fixing the copper tube fittings only Teflon tapes should be used. However, no tape shall be used while tightening the ferrules.

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2.3.11.0	Instrument Air line Testing a. All instrument air lines shall be isolated from the instruments and pressurized pneumatically to maximum working pressure. It shall then be isolated from the source of pressure and fall shall be less than 1 psi in 20 minutes. b. All pneumatic signal lines shall be disconnected and blown through with instrument air. The line shall be blanked off and pressurized pneumatically 20 psi, and checked with soap solution for leak.
2.3.12.0	General Guidelines on Installation of Flexible Hoses
2.3.12.1	Flexible hoses can be classified into two broad categories, viz., Rubber hoses and Metallic hoses. The selection of the hoses is made depending upon the service conditions (pressure, temperature and other environmental conditions).
2.3.12.2	Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shrinkage or expansion. (However, excessive slack in hose lines is one of the most common causes of poor appearance).
2.3.12.3	At bends, provide enough hose for a wide radius curve. Too tight a bend pinches the hose and restricts the flow. The line could even kink and close entirely. In many cases, use of the right fittings or adapters can eliminate bends or kinks.
2.3.12.4	In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible and proper installation protects metal parts from undue stress, and avoids kinks in the hose.
2.3.12.5	Hose assemblies in service should be inspected frequently for leakage, kinking, corrosion, abrasion or any other signs of wear or damage. Hose assemblies that are worn or damaged should be removed from service and replaced immediately.
2.3.12.6	The service life expectation of a flexible hose mainly depend on the correct installation layout. In most cases, when flexible hoses fail prematurely, the reason of failure may be found in an incorrect layout.
2.3.12.7	As a rule, the hose is not to be bent over its limit of elasticity. The choice of the right hose length is of crucial importance. The hose should not be subject to torsion. Torsion can be usually eliminated by changing the layout.
2.3.13.0	General Notes on Installation of Local Instrument Racks and JB Frames
2.3.13.1	In cases where the local instrument stands are to be installed on a concrete foundation, it shall be fixed by anchor bolts.
2.3.13.2	Installation of local junction boxes shall be installed in such a way that they are fixed on a column by welding or by fixing bolts.
2.3.13.3	Local Instrumentation rack, which shall be installed utilising the Beam and Structure, shall be fixed by welding. Care shall be taken while deciding the location in order to ensure that no hindrance is caused to the maintenance

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

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

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2.3.15.4	For pressure more than exceeding 40 kg, 2 isolating valves shall be provided.
2.3.15.5	In the case of heavy duty isolating valves, suitable support shall be provided to avoid any loading on the stubs.
2.3.15.6	In viscous fluids, suitable steam tracing shall be provided.
2.3.15.7	These valves are always located as nearer to the measuring device as possible.
2.3.16.0	Blowdown Valves or Drain Valves a. These valves are fixed at the lowest end of impulse pipe b. In the case of high-pressure line always 2 valves shall be fitted in series. Normally, these valves will be of globe type c. For low-pressure application, single valve is used. d. In case of air and flue gas measurements, either a plug or a suitable gate valve of gunmetal 'on/off' valve shall be provided. e. The drain valve shall be connected to the common drain header which finally is terminated at plate operation drain system.
2.3.17.0	PAINTING: All the supporting steelworks impulse pipe shall have protective painting. The surface shall be free from rust, foreign adhering matters, grease etc. Two coats of rust preventing red-oxide primer and final painting of two coats as per the colour DECIDED by the site engineer. After cleaning the surface is painted with one coat of Red oxide zinc chromate primer confirming to IS 2074 and allowed to dry completely. The primer-coated surface is painted with two coats of final painting of desired colour which shall be selected from IS-5.
2.3.18.0	GUIDELINES FOR CABLE LAYING
2.3.18.1	In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.
2.3.18.2	In case of multicore cables of diameter upto 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.
2.3.18.3	Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.
2.3.18.4	GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
2.3.18.5	In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy-duty PVC pipes shall be provided.
2.3.18.6	Entry of cables through trenches/tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.

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

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

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	In hierarchical order: a. Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them. b. LT power cables are mixed up with control cable with clear minimum gap of 150mm between them. c. LT power cables are mixed up with HT power cables with clear minimum gap of 200 mm between them. d. LT power cables are mixed up with special control cables with clear minimum gap of 200mm between them.
2.3.18.32	In case of duplicate feeders to essential loads, the respective cables shall be laid through separate raceways. Alternatively, such cables shall be laid on the opposite sides of a trench/tunnel/basement.
2.3.18.33	For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanised.
2.3.18.34	For laying cables along concrete walls, ceilings etc. The cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 6mm thickness.
2.3.18.35	To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.
2.3.18.36	No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits / pipes in trefoil formation only.
2.3.18.37	In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.
2.3.18.38	Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.
2.3.18.39	Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.
2.3.19.0	Support Spacings & Clampings: Support spacing and clamping suitably provided and as required.
2.3.20.0	Laying of cables directly buried in ground: Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.
2.3.21.0	Codes and Standards:

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	Installation of cabling work shall comply with the following Indian Standards (Latest editions): IS 1255 Code of practice for installation and maintenance of power cables upto and including 33 kV rating. IS 732 Electrical wiring installation (system voltage not exceeding 650 V). IS 5216 Guide for safety procedures and practices in electrical works. IS 226 Structural steel (Standard quality). IS 800 Code of practice for use of structural steel. IS 316 Code of practice for use of metal arc welding for general construction in mild steel. IS 1363 Hexagonal bolts, nuts and screws IS 1572 Electroplated coatings of cadmium on iron and steel. IS 2629 Code of practice for hot dip galvanising for iron and steel. IS 2633 Method of testing uniformity of coating on zinc coated articles. In addition to the standards mentioned above, all works shall conform to the requirements of the following rules and regulations. a. Indian Electricity Act and Rules framed thereunder b. Fire insurance regulations c. Regulations laid down by the Chief Electrical Inspector of State d. Regulations laid down by the Factory Inspector of State e. Any other regulations laid down by the authorities. In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.
2.3.22.0	Guidelines For Erection of Cable Trays, GI Pipes, Supports and Accessories
2.3.22.1	Constructional details and supporting arrangement for the cable trays shall be as shown in the drawings which will be handed over to the successful bidder. All cable trays, vertical raceways and supporting steel work shall be installed along the routes as indicated in the drawings and as per the instructions of the Engineer-in-charge. The contractor has to fabricate and install complete tray supporting structures as per the drawing / site requirement.
2.3.22.2	Wherever specified or directed by Engineer, the contractor shall install galvanised MS sheets covers over cable trays. The width of the covers shall be same as that of cable trays. Bolting shall be done to fasten covers to the cable trays, elbows, reducers, tees, crosses etc.
2.3.22.3	The contractor shall install all angles, channels, beams, hangers, brackets, clamps etc. as may be necessary to suit the actual site conditions to support the cable trays.

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2.3.22.4	Straight pieces of standard MS angles / channels shall be used for fabrication of supports / racks. All welded joints shall be smooth enough to provide a good appearance and shall not cause injury to working personnel.
2.3.22.5	Cable trays within cable trenches, tunnels and basements shall be of ladder type. Bottom most tray within plant buildings for overhead runs of trays shall be of perforated type. Cable trays in the areas exposed to coal dust shall be installed in vertical formation. Wherever due to layout constraints, it is not possible to install the trays in vertical formation with Engineer's prior permission installing the trays in horizontal formation may be considered.
2.3.22.6	Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way or maintenance of adjacent equipment.
2.3.22.7	For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.
2.3.22.8	For equipment and devices having GI conduit entry arrangement other than standard GI conduit adopter, adopters shall be provided as required to enable the GI conduit to be properly terminated, between conduit end and motor T.B.
2.3.22.9	GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.
2.3.22.10	The entire G.I. conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the Gi pipes entering them.
2.3.22.11	Bends of G.I. pipes / conduits shall be made without causing damage to the pipes / conduits.
2.3.22.12	Occupancy of conduits shall not be greater than 40%.
2.3.22.13	The adopter for coupling rigid GI pipe / conduits and flexible conduit shall be of aluminum or galvanized steel.
2.3.22.14	Transportation and storage of cable drums
2.3.22.15	Transportation and storage of cable drums shall generally conform to the requirements of IS : 1255
2.3.22.16	All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.
2.3.22.17	The cable drums shall be transported on wheels to the place of work.
2.3.23.0	GUIDELINES FOR CABLE TERMINATION AND JOINTING
2.3.23.1	Contractor shall carry out cable terminations at various electrical and electronic equipment terminals.
2.3.23.2	When the equipment are provided with undrilled gland plates for cable / conduit entry into the equipment, drilling and cutting on the gland plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before drilling holes. Cutting shall not be allowed.

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2.3.23.3	Termination of cables shall be done as per termination drawings & interconnection diagrams furnished to the contractor. Looping of cores / wires at terminals as shown in interconnection diagrams is to be done by the column at no extra cost as part of the termination.
2.3.23.4	All cable entries in the equipment shall be sealed after glanding the cables.
2.3.23.5	Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core / conductor.
2.3.23.6	Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals.
2.3.23.7	Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes / nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.
2.3.23.8	Screened control cables of 0.5 sq.mm cross-sectional area shall be terminated by means of wire rapping system.
2.3.23.9	Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per the control schemes and other related documents supplied.
2.3.23.10	End sealing / termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.
2.3.23.11	Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs.
2.3.23.12	Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.
2.3.23.13	Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.
2.3.23.14	Junction boxes shall be used, wherever required, for jointing of control cables.
2.3.23.15	Termination and jointing shall generally conform to the requirements of IS: 1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.
2.3.24.0	DESIGN REQUIREMENTS OF ITEMS SUPPLIED FOR CABLING INSTALLATION WORK (IF SUPPLY IS COVERED IN BIDDER SCOPE)
2.23.24.1	STRIP CABLE CLAMPS:

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	a. Strip Clamps shall be of aluminium alloy or cast steel or M.S. and shall be used to fasten the group of multicore cables on the tray. b. Clamps shall be of simple construction, made of 4 mm thick, 25 mm wide strip to cover the entire width up to 300 wide tray and part of the tray for more than 300 wide trays. Strip shall have two right angle bends for fixing on the rung with two bolts. c. Clamps shall be of different lengths for different sizes of tray width. The maximum size of clamp width shall be 300 mm and for cable trays of greater width, two clamps shall be used.
2.23.24.2	SELF LOCKING CLAMPS: a. Clamps shall be of nylon material / fibre glass. b. Clamps shall have self-locking feature when the cord is looped. c. Clamps shall be proved with manual lock release. d. Clamp cord shall not move in the backward position once it has been locked unless the lock release is applied. e. Type test certificates to ascertain the strength of clamps shall be submitted for Purchaser's approval. f. Nylon self-locking clamps shall be of BHEL approved make only.
2.23.24.3	FERRULES: a. Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter. b. Ferrules shall be of plastic material. c. Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave coloring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600 mm. d. Ferrules shall be interlocking type in such a way that the interlocked ferrules take the shape of tube with complete ferrule number appearing in a straight line.
2.23.24.4	TAGS: a. Cables shall be provided with cable number tags for identification. b. Cable tags shall be of durable fiber, aluminum, stainless steel sheets or lead of suitable thickness. c. Cable number shall be engraved type in case of aluminum or stainless steel tags, and printed type in case of fiber sheet. d. Tags shall be durable quality of size 60mm x 12mm with holes at both ends. e. Samples of tags shall be approved by BHEL Engineer before delivery. f. Tags shall be provided with non-corrosive wire of sufficient strength for tagging's.
2.23.25.0	GUIDELINES FOR EARTHING INSTALLATION:

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2.23.25.1	All equipment shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.
2.23.25.2	The earthing conductors shall be mild steel / G.I. strips / wires. All connections from the equipment to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the successful tenderer.
2.23.25.3	A continuous earthing conductor shall be installed in all cables trays and securely clamped to each tray section by suitable connectors to form a continuous earthing system. When two or more trays supporting power cables run on parallel a continuous earthing conductors shall be provided on one tray only with tap offs to the control cable trays. All valve and damper motor and rapping motors will be earthed to this conductor.
2.23.25.4	All joints in the earthing system shall be welded type. Earthing connections to all equipment including motors shall be bolted type.
2.23.25.5	Earthing connections shall be free from tinning scale, paint, grease, rust or dirt at the time of making joint.
2.23.25.6	Metallic sheaths, screens / shields and armor of all multicore cables shall be bonded and earthed.
2.23.25.7	Earthing conductors along with their run on columns, beams, walls etc., shall be supported by suitable cleats at intervals of 750 mm.
2.23.25.8	Conduits shall be bonded together and grounded at all switchgear and control centers.
2.23.25.9	M.S.Earthing conductors shall be coated with one coat of bituminous paint, wrapped with a layer of bitumen tape and finally coated with bitumen paint. For site welded GI strips / wires required coat of aluminium paint should be given.
2.23.25.10	If the equipment is not available at the time of earthing conductor laying tap connections from the main earthing conductor shall be brought out up to slab equipment foundation level with at least 200 mm spare length left for further connections to equipment earthing terminals.
2.23.26.0	Guidelines for Erection of Control Panels and Distribution Boards
2.23.26.1	The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base channels will have to the grouted. Suitable concrete drilling machine shall be used for making hole on the concrete floor.
2.23.26.2	For the panels which are to be mounted on the trenches, channel supports have to be provided across the cable trenches over which the base frames of the panels shall be mounted. Fabrication and installation of these support structures shall be carried out as per drawings.

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2.23.26.3	All the panels / board shall be placed on its foundation or supporting structures and shall be assembled equipment as required. All equipment should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.
2.23.26.4	All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.
2.23.27.0	The following points shall be checked up during erection i. Layout of foundation channels. ii. Floor level covered by the panel with respect to main floor level. iii. Location and serial no. panels. iv. Positioning of panels. v. Verticality of panels and breaker truck to station earth. vi. Earthing of panels and breaker truck to station earth. vii. Lugs for termination of HT and LT cables. viii. Mounting and fixing arrangements all modules. ix. Check the operation of: a. Remote control b. Various required - closing / tripping / alarm / indications / interlocks Installation position of instruments and relays Operation of relays and instruments. x. AC / DC supplies for panel. xi. Tightness of terminal connections for HT & LT connections. xii. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.
2.3.28.0	415 V SWITCHGEAR AND ELECTRICAL PANEL TESTS (AS APPLICABLE) a. IR Test on each pole of breaker b. IR test on control circuit c. Measurement of contact resistance for all three phases of breaker d. Measurement of resistance of the closing and tripping coil of breaker e. Checking the close trip operation at 70% and 100% of the rated auxiliary D.C. Voltage. f. Checking of interlocks provided and tripping of breaker through relays

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	g. Space heater operation check h. Opening and closing time check i. Control and metering circuit checks j. Primary and secondary injection tests k. Thermal overload relay testing and checking l. Calibration of all instruments and meters m. Phase rotation checks n. High voltage test on 7C.1.3 kV switchboard														
2.3.29.0	CUTTING & WASTAGE ALLOWANCE: The following scrap allowances are permissible: <table border="1"> <thead> <tr> <th>Sl.No.</th><th>Description</th><th>Non-Salvageable</th><th>Unaccountable</th></tr> </thead> <tbody> <tr> <td>01</td><td>Length below 0.5 m steel pipes Stainless/ Copper tubes, Single Pair Cables</td><td>2 %</td><td>0.5 %</td></tr> <tr> <td>02</td><td>Length below 20 m multi cable, multi tubes.</td><td>2 %</td><td>0.5 %</td></tr> </tbody> </table>			Sl.No.	Description	Non-Salvageable	Unaccountable	01	Length below 0.5 m steel pipes Stainless/ Copper tubes, Single Pair Cables	2 %	0.5 %	02	Length below 20 m multi cable, multi tubes.	2 %	0.5 %
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2.3.30.0	GUIDELINES FOR HANDLING OF SOLID STATE MODULES: a. All the solid-state modules shall be handled by qualified person. b. Electronic modules should only be touched when it is absolutely essential. c. Before touching any electronic modules, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strip. d. The operator should not wear clothing made entirely from synthetic fibres, but a mixture containing atleast 65% cotton. e. PCB should always be held by the front panel or by the module frame and the electronic components should never be touched. f. The electronic modules should never be placed close to television sets or CRT units. g. Soldering irons and any other tools used must be grounded. h. All modules using CMOs components are packed in antistatic bags, when transported loose to avoid ESD failures. The antistatic bags must always be used to transport modules at site from one place to the other.														

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2.3.31.0	GUIDELINES FOR LANDING AND STORAGE OF ELECTRONIC CUBICLES / SUB-ASSEMBLIES / LOOSE ITEMS.
2.3.31.1	Immediately after unloading at site, the electronic equipment should be kept in the covered area. Handling and lifting of the package should be done without jerks or impacts. Packing case should not be dripped or slid along the floor under any circumstances. Suitable forklift should be used to move the case to its final position. All the above points are to be strictly followed as the electronic equipments cannot withstand any stress due to vibration and shock.
2.3.31.2	After unloading at site, the package of the equipment shall be inspected for external damage. In case the package is damaged, the package number and details of the damage should be noted. The details of the damage should be reported to the responsible site Engineer.
2.3.31.3	Cases should be opened / unpacked using correct nail pullers. While opening the planks, care should be taken to see that the equipment is not damaged. Cases should not be unpacked in areas where they are exposed to rain water / liquid splashing, dust or other harmful materials like chlorine gas, sulphur dioxide etc.
2.3.31.4	After opening the case, all supports provided for transport are to be removed with due care.
2.3.31.5	Hinged frames should not be opened when equipment is not secured to the floor as this is likely to cause it to topple over. The hinged frame can be opened only if the equipment is still fixed on to the bottom wooden pallet.

VOLUME-IA PART – II

CHAPTER 4 to 6

Next pages are as below

Chapter 4	Drawings & Schemes a. HMI Configuration drawings b. Write up on Lab Instruments	65
Chapter 5	T&P Hire Charges	13
Chapter 6	“HSE Plan for Site Operations by Subcontractor” (Document No. HSEP: 14 Rev01)	82

HMI CONFIGURATION DIAGRAM

PROJECT : YADADRI TPS, NALGONDA (5 x 800 MW)
WBS No. : CE/1276-SH1-56-01
TO
CE/1276-SH5-56-01
CE/1276-SHC-56-01
BHEL DRG. No. : EN-DG-1276-145-4001

TATA CONSULTING ENGINEERS LIMITED	
VENDOR DOCUMENT REVIEW STATUS	
☒ A	Drawing/Document approved as submitted. Proceed with fabrication/construction.
☐ B	Drawing/Document approved subjected to comments noted. Proceed with fabrication/construction considering our comments.
☐ C	Our comments are noted on this marked up print.
☐ D	Our comments are noted in memo attached to the forwarding transmittal letter No. TCE11005A-IG-V01-276 Dated 27-01-2020
☐ E	Correct original of this drawing/document to reflect our comments and resubmit for approval.
☐ F	Correct original of this drawing/document to reflect our comments and resubmit for records.
☐ G	Drawings/Documents of this category are for information only and not for approval. Information furnished on the drawing/document is noted.
☒ H	Drawing/Document reviewed against our previous comments and other revisions highlighted and identified by the vendor.
☐ I	Drawing/Document returned without review.
☐ J	Print not enclosed.
Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance requirements and conformity of the supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchaser's rights under the contract.	
Reviewed by.....NC.....Date.....27-01-2020	

THIS DOCUMENT SHOULD BE READ ALONG WITH :

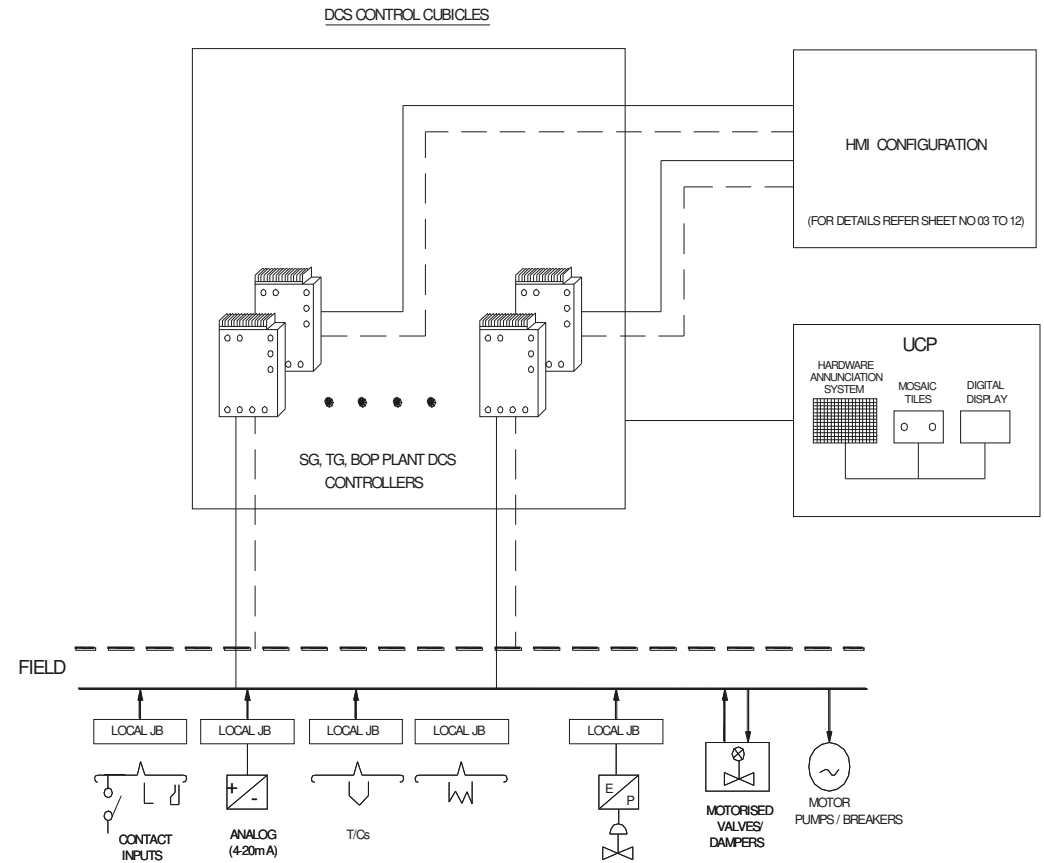
1. FUNCTION GROUPING DOCUMENT (EN-DG-1276-145-5001)AND
2. CONTROL SYSTEM FOR MECHANICAL AUXILIARIES PACKAGES (PE-DM-417-145-I900)

JOB NO.	417
STATUS	CONTRACT
DISTRIBUTION	

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

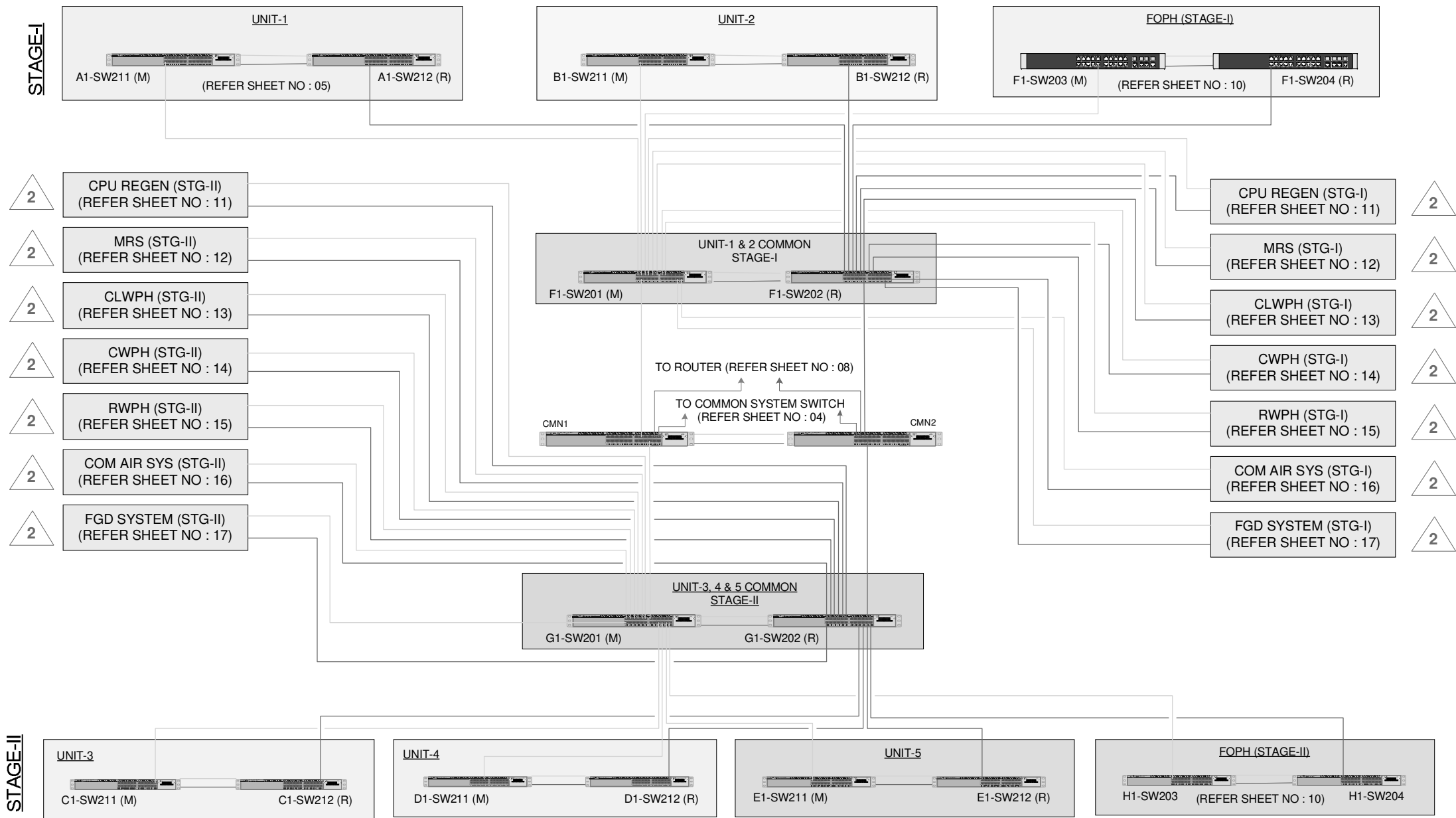
CUSTOMER	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, NALGONDA																							
CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE INDIA																							
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA						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

OVERALL DCS CONFIGURATION FOR UNIT-1 TO UNIT-5



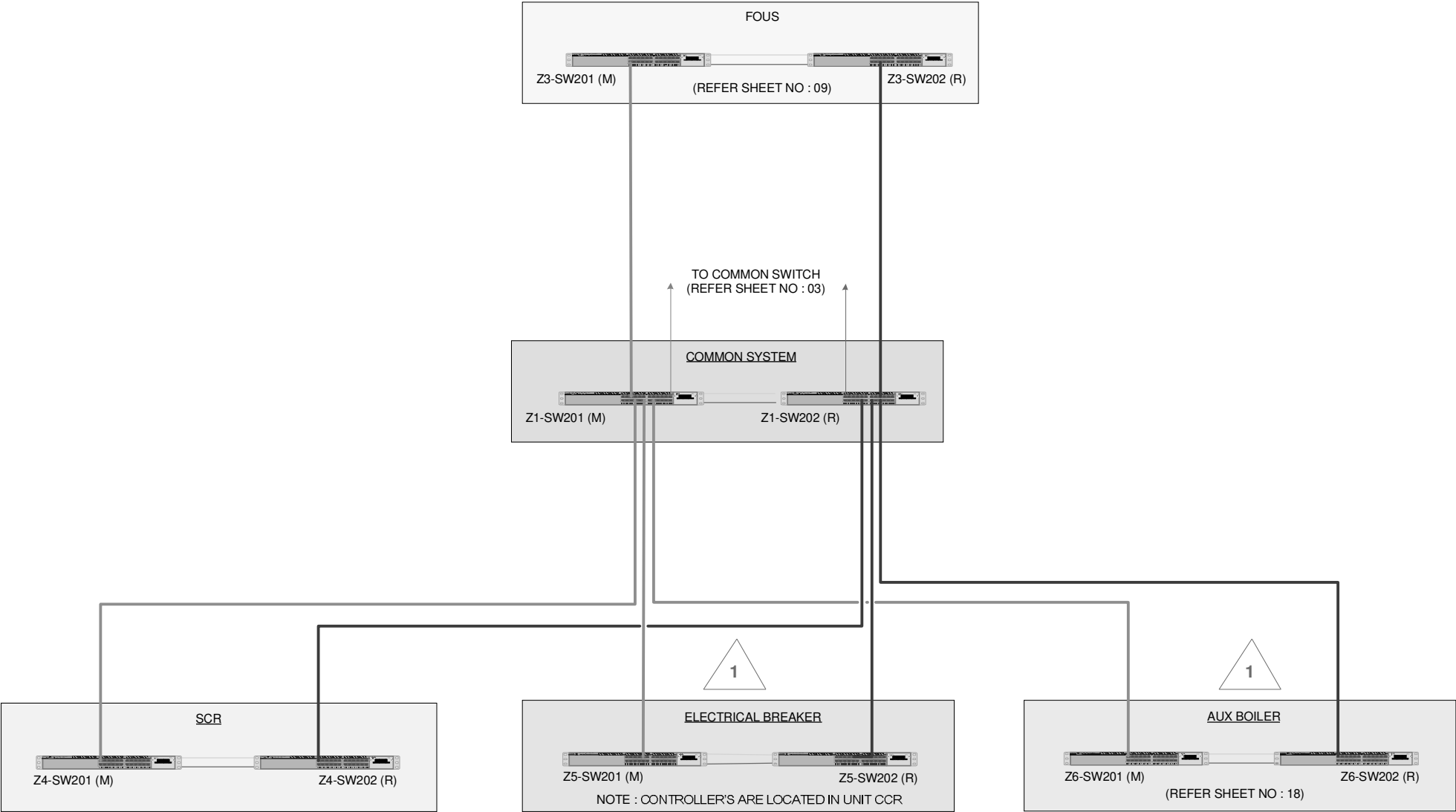
						Valmet	बी एच ई एल BHEL	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER		
								OBJECT			
								MODEL			
DATE	NAME	APPD	REVISION			REV.NBR	TITLE				
DESIGN.	BHASKAR \ 01-03-2019		CHKD	REETESH \ 01-03-2019		APPD	ABHISHEK \ 01-03-2019		OVERALL DCS CONFIGURATION FOR UNIT-1 TO UNIT-5		
FILE				APPLA		PROD.	HMI System		DCC	DRAWING ID/REV	SHEET
										EN-DG-1276-145-4001	02 02 (21)

HMI CONFIGURATION DIAGRAM OVERVIEW



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

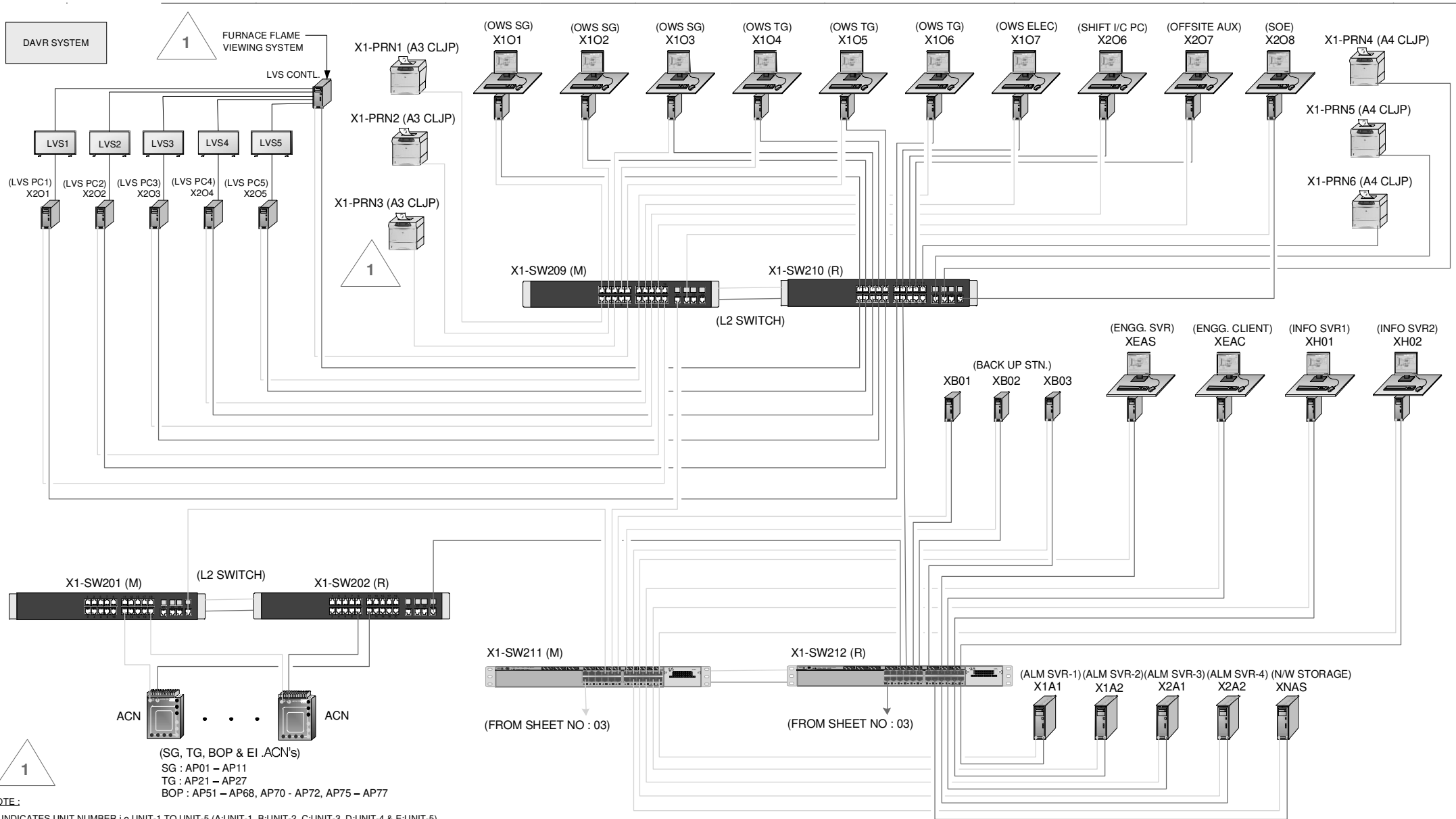
HMI CONFIGURATION DIAGRAM OVERVIEW



AHP & CHP REMOVED

								PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER		
								OBJECT				
								MODEL				
DATE		NAME	APPD	REVISION				REV.NBR		HMI CONFIGURATION DIAGRAM OVERVIEW		
DESIGN.		BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019				
FILE				APPLA								
				PROD.		HMI System				DCC	DRAWING ID/REV EN-DG-1276-145-4001	SHEET 02 04 (21)

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



DATE NAME APPD REVISION REV.NBR

DESIGN. BHASKAR \ 01-03-2019 CHKD ABHISHEK \ 01-03-2019 APPD REETESH \ 01-03-2019

FILE APPLA



PROJECT YADADRI TPS (5 x 800MW) - TSGENCO

OBJECT

MODEL

CUSTOMER

CUSTOMER DWG NR

TITLE

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

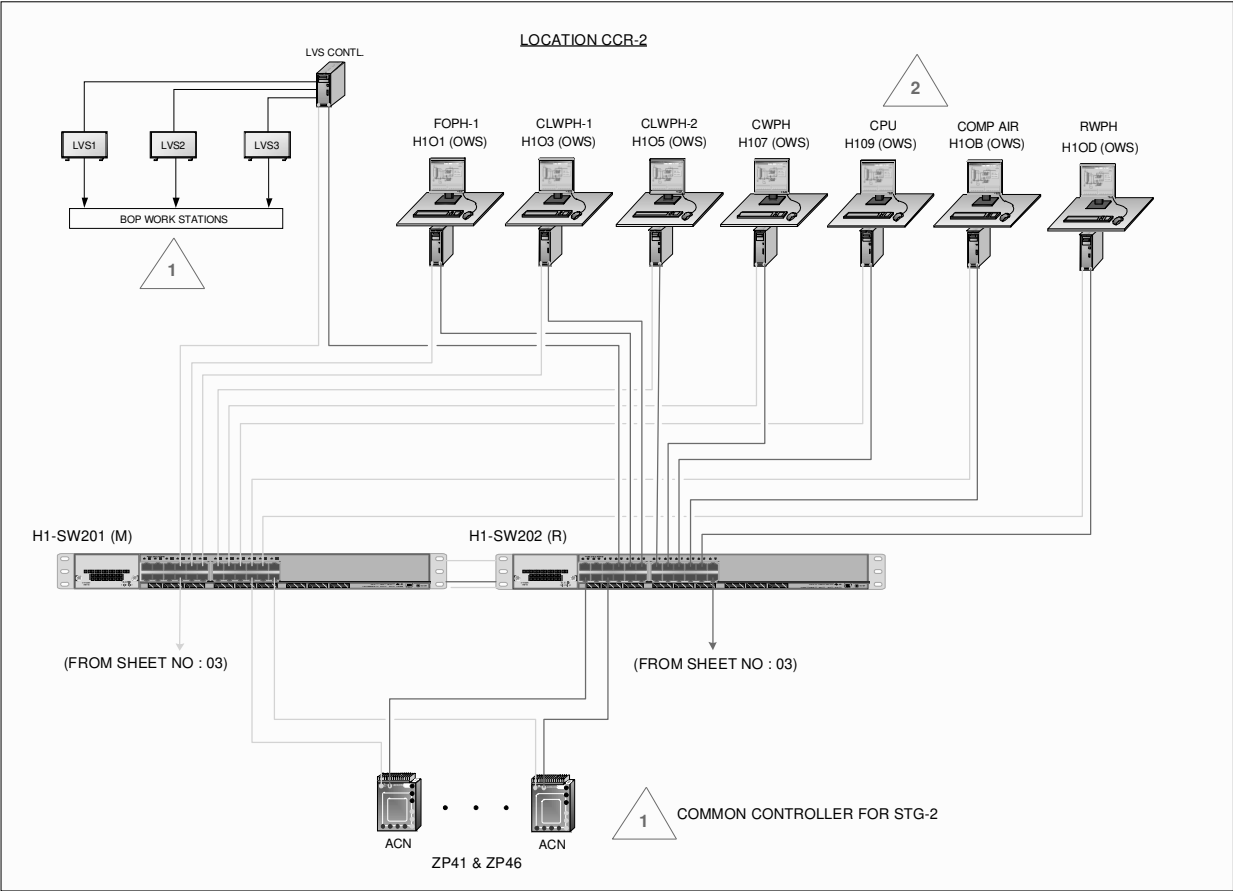
PROD. HMI System

DCC

DRAWING ID/REV

EN-DG-1276-145-4001

02 05 (21)



*** BOP SYSTEM**

OWS OWS PRINTER

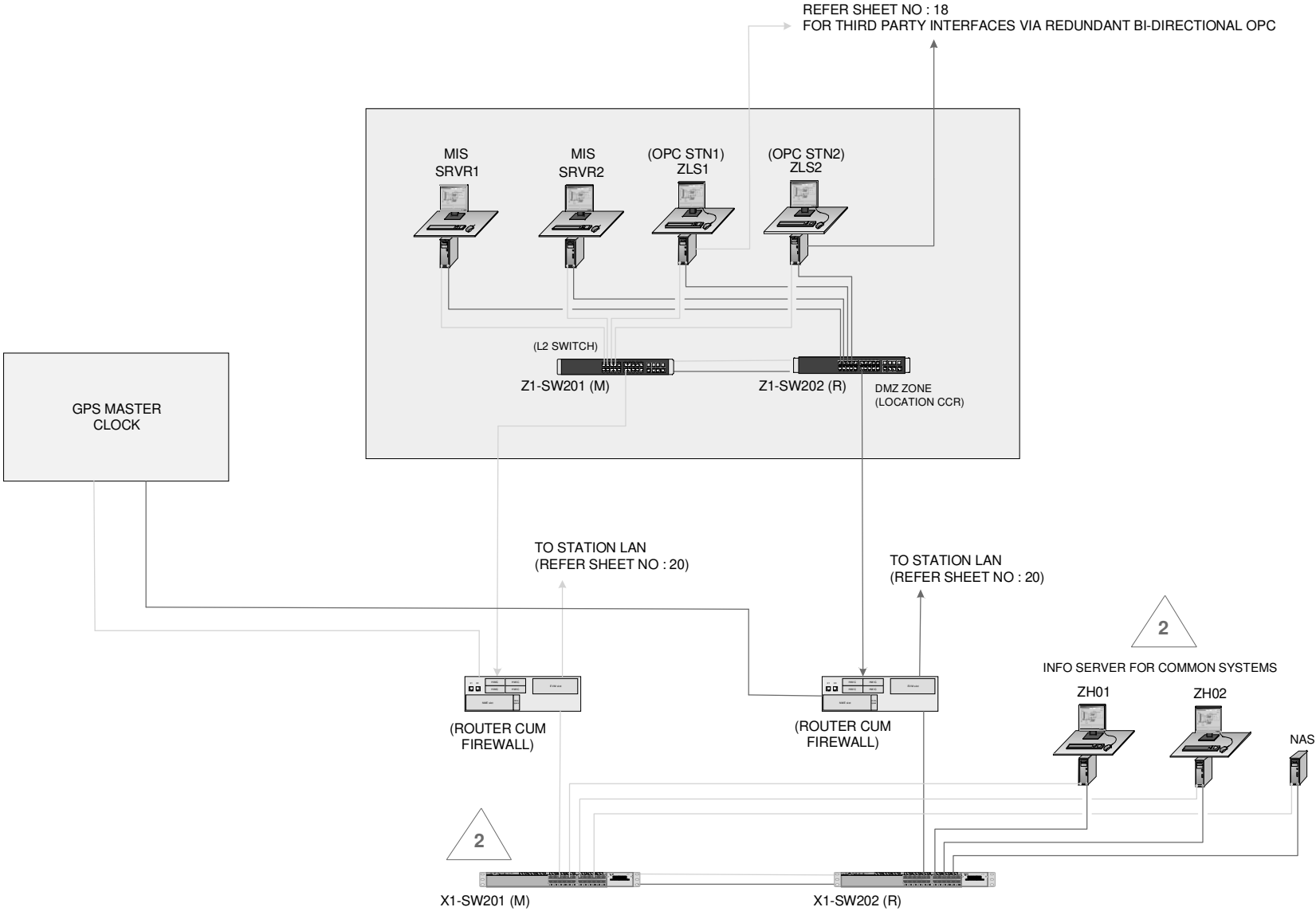
PC DETAILS

- ACVS – 1 NO
- HYDROGEN GENERATION PLANT – 1 NO
- FIREWATER PUMP – 1 NO
- FIRE WATER DETECTION SYSTEM – 1 NO + 1 NO Printer
- CHP – 1 NO
- AHP – 1 NO
- PT PLANT – 1 NO
- DM PLANT – 1 NO

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

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

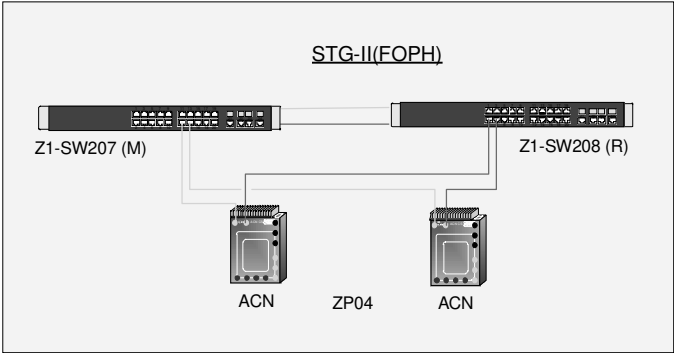
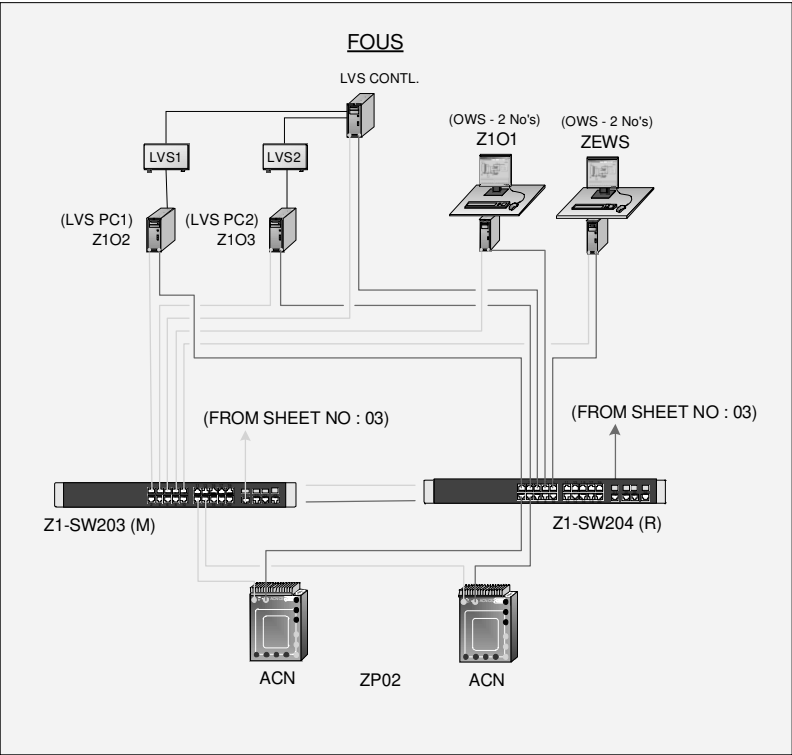
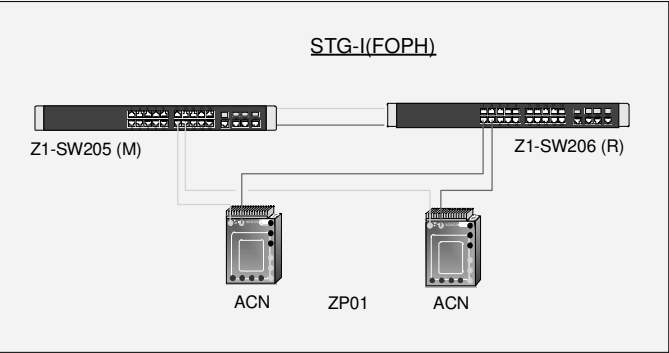
HMI CONFIGURATION COMMON FOR 5 UNITS



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

								PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER												
								OBJECT														
										MODEL												
DATE		NAME	APPD	REVISION			REV.NBR	TITLE			DCC			DRAWING ID/REV			SHEET					
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019														APPD		REETESH \ 01-03-2019
FILE					APPLA					PROD.		HMI System				EN-DG-1276-145-4001			02	09 (21)		

HMI CONFIGURATION FOR FOUS AND FOPH (LCR)

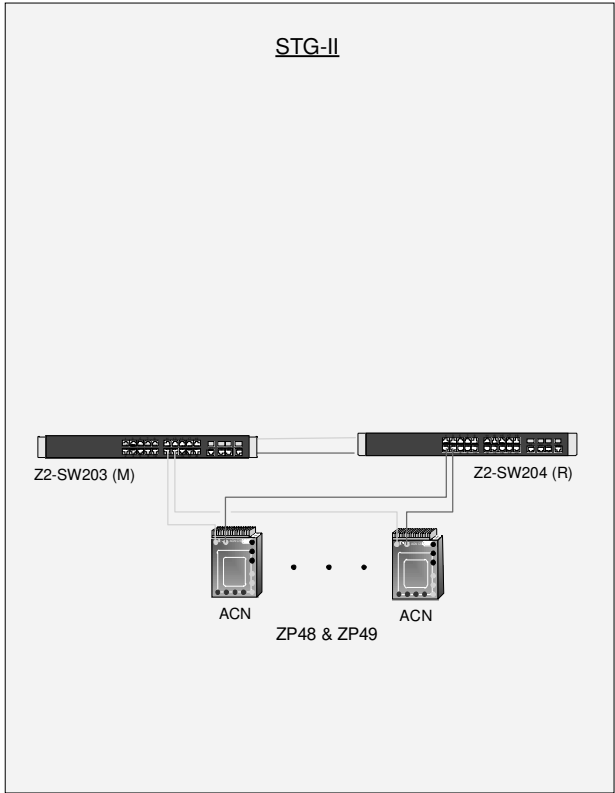
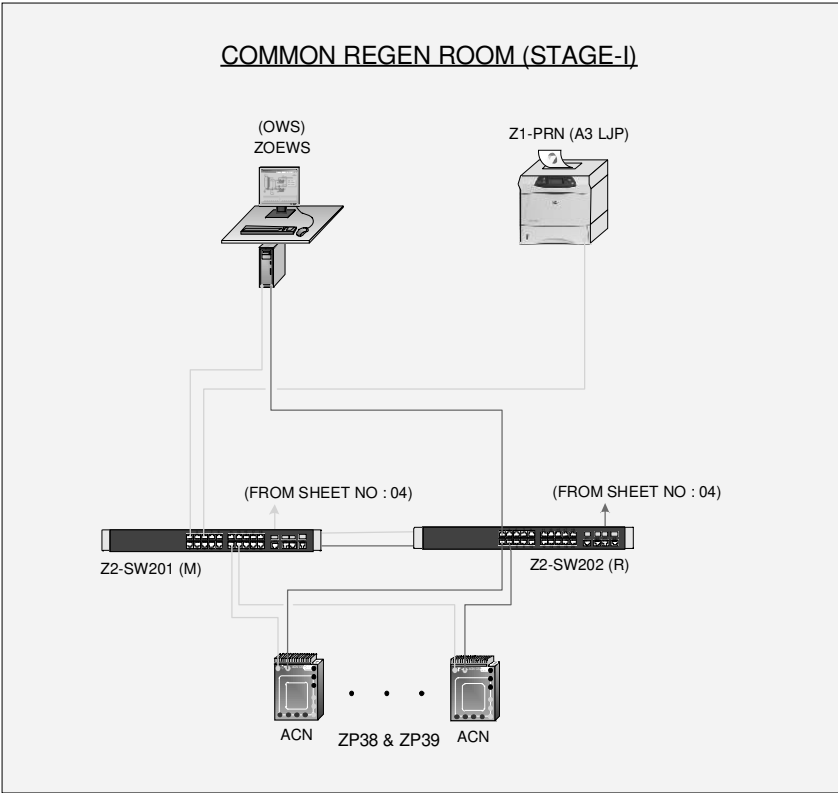


NOTE :
HFO TRUCK UNLOADING AND LDO TRUCK UNLOADING IS IN MAIN CONTROLLER WITH MIMIC AND BACKUP PANEL
#RIO AT HFO UNLOADING TRAIN AREA WILL BE CONNECTED TO ZP02 WITH MIMIC BACKUP PANEL

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

				 	PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO			CUSTOMER			
					OBJECT							
					MODEL							
DATE	NAME	APPD	REVISION		REV.NBR	TITLE			DCC	DRAWING ID/REV		SHEET
DESIGN.	BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019			HMI CONFIGURATION FOR - FOHS (FOPH LCR)-COMMON FOR 5 UNITS		
FILE			APPLA			PROD.		HMI System		EN-DG-1276-145-4001		
											02	10 (21)

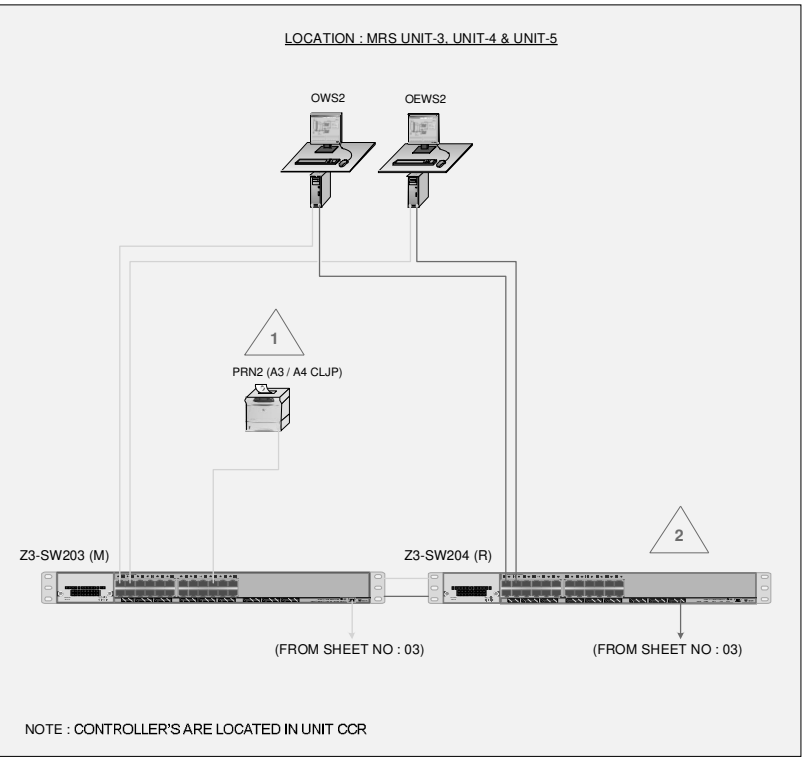
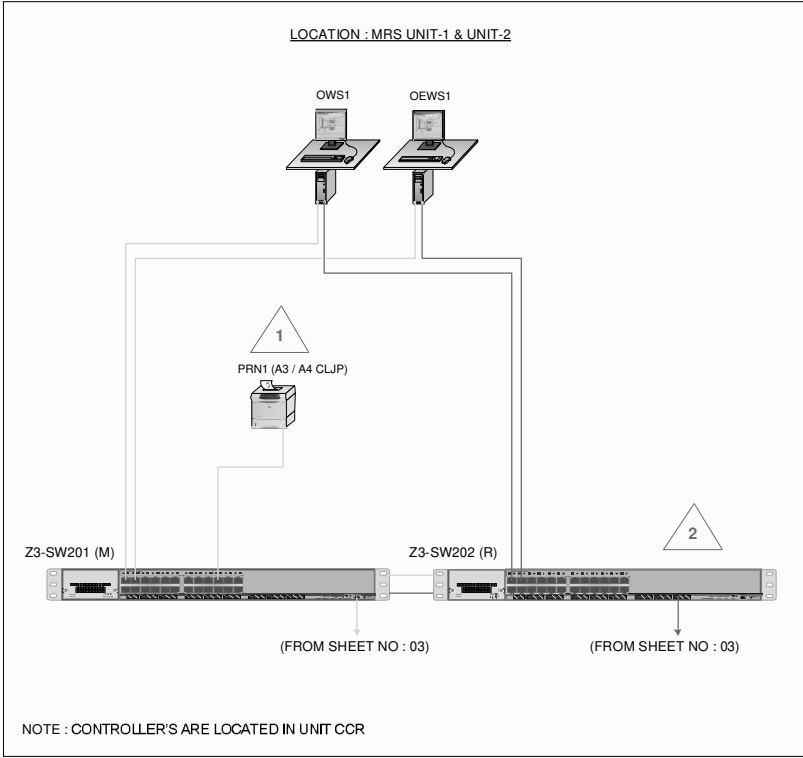
HMI CONFIGURATION FOR- COMMON REGEN ROOM (STAGE-I&II)



NOTE : UNITIZED DCS IS IN SERVICE VESSEL IN CCR

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

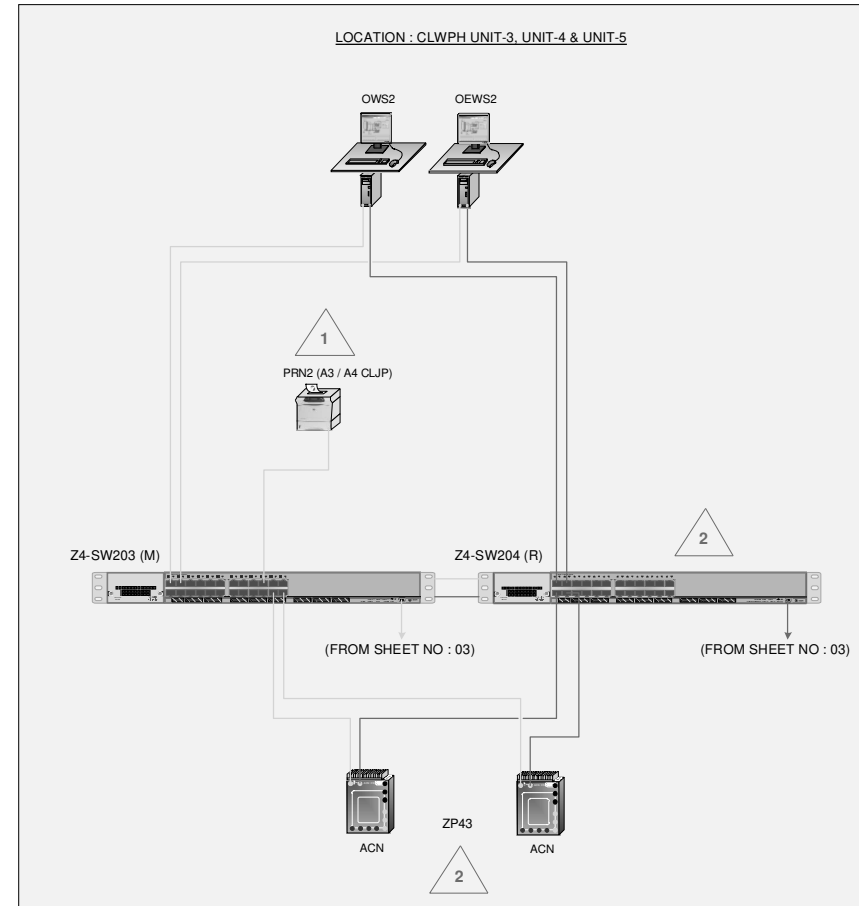
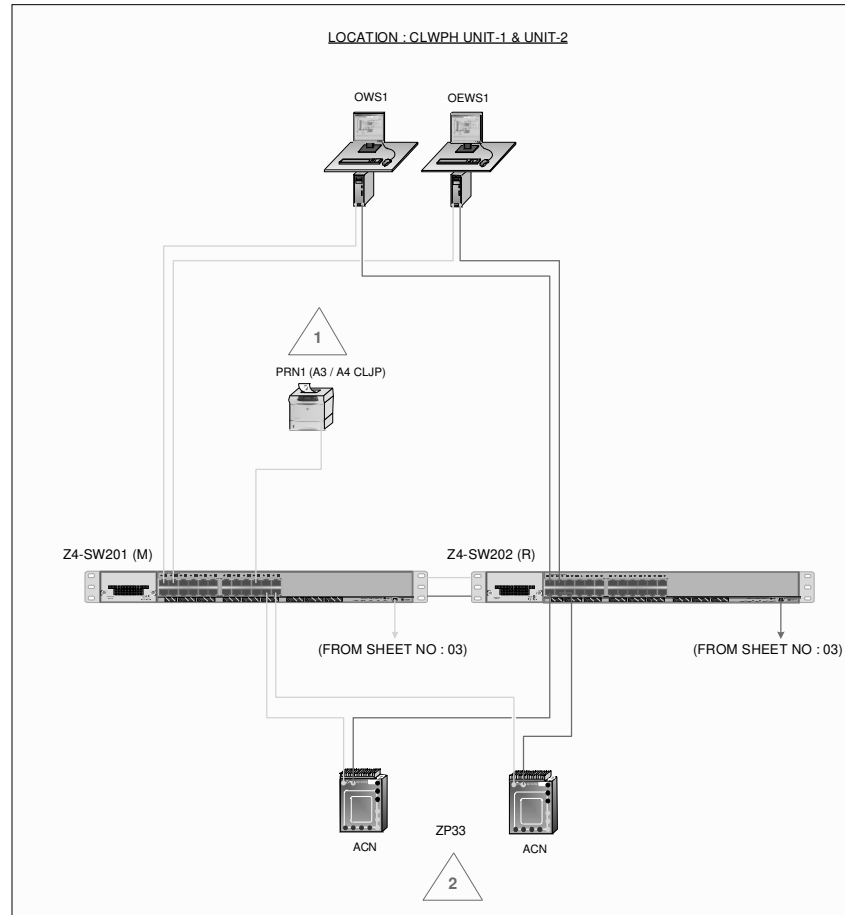
								PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER								
								OBJECT										
								MODEL										
DATE	NAME	APPD	REVISION			REV.NBR	TITLE			DCC			DRAWING ID/REV		SHEET			
DESIGN.	BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019		HMI CONFIGURATION FOR- COMMON REGEN ROOM (STAGE-II)									
FILE			APPLA			PROD.			HMI System									
												EN-DG-1276-145-4001		02	11 (21)			



1 STAGE WISE CONTROLLER WILL BE PROVIDED IN CCR

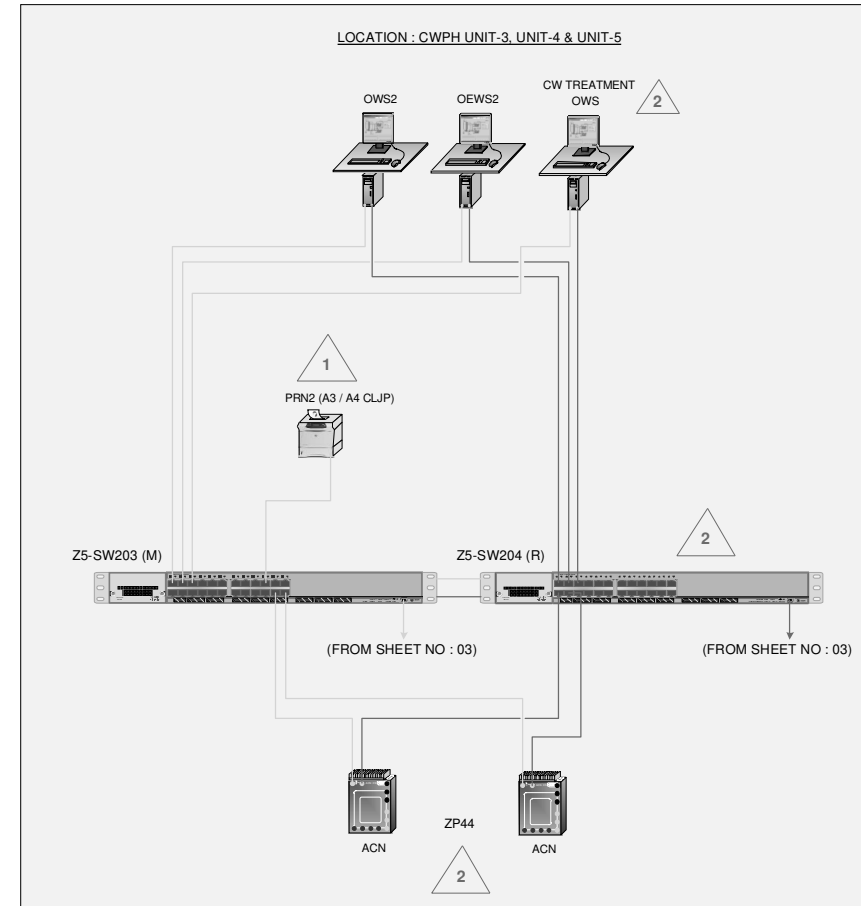
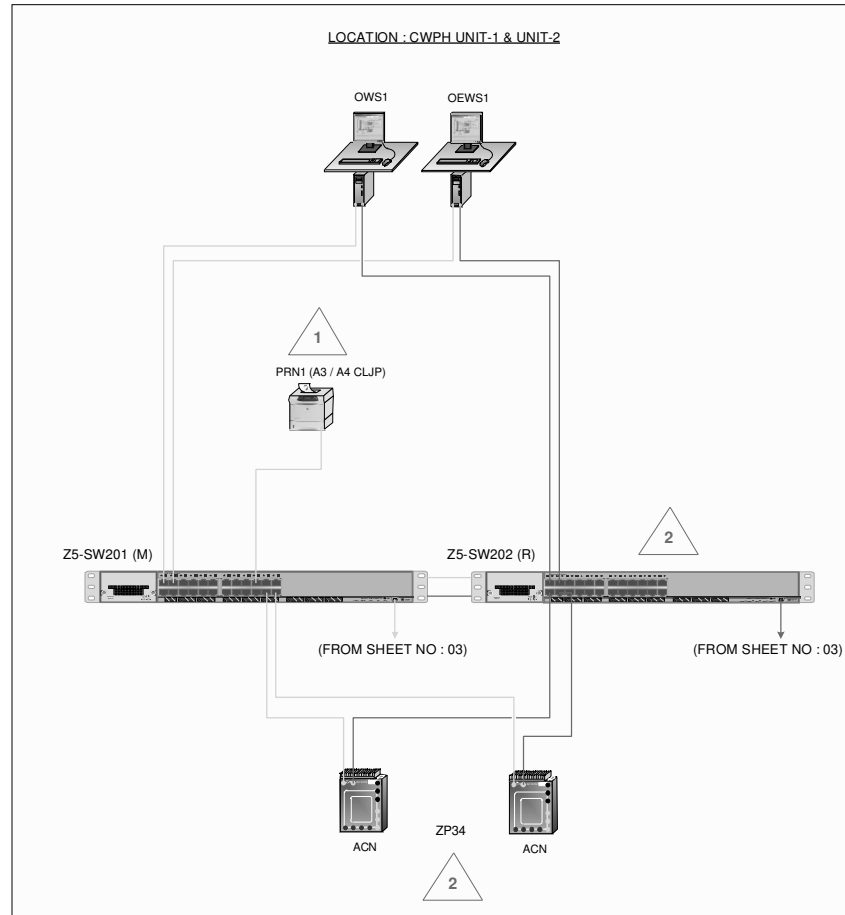
NOTE : BACKUP PANEL WITH COLOURED MIMIC, PB LAMPS, ANNUNCIATION WILL BE SUPPLIED BY BHEL EDN

								PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER					
								OBJECT							
								MODEL							
DATE		NAME	APPD	REVISION				REV.NBR		TITLE HMI CONFIGURATION DIAGRAM (MRS)					
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD				REETESH \ 01-03-2019			
FILE				APPLA				PROD.				HMI System			
										DCC		DRAWING ID/REV		SHEET	
												EN-DG-1276-145-4001		02	12 (21)



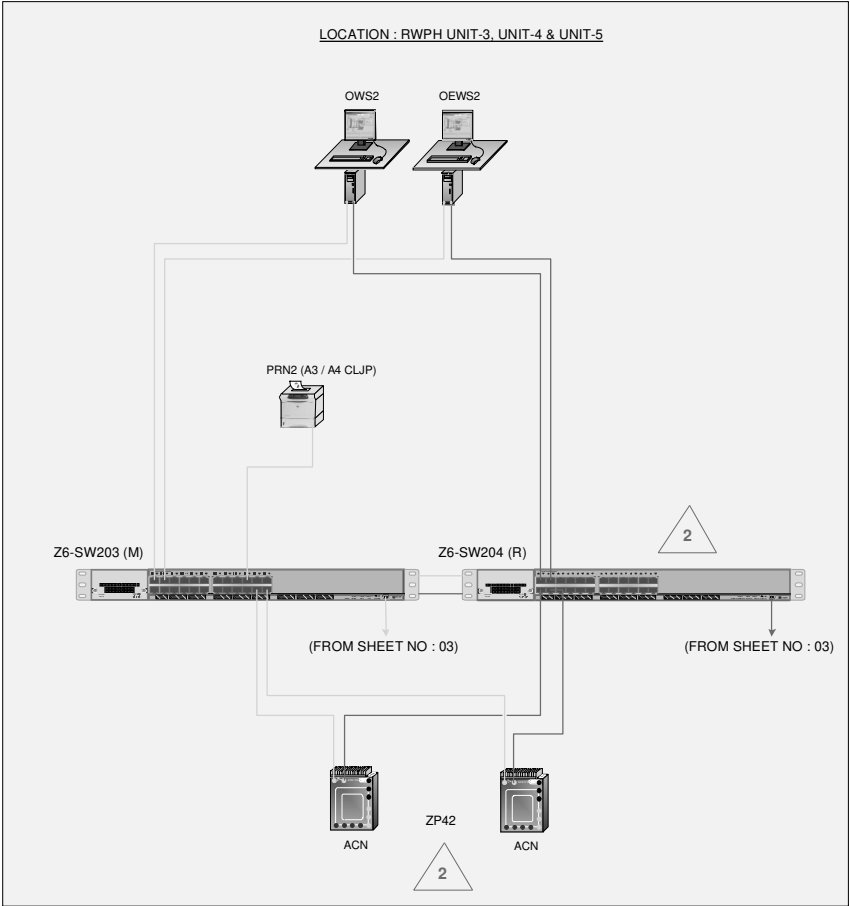
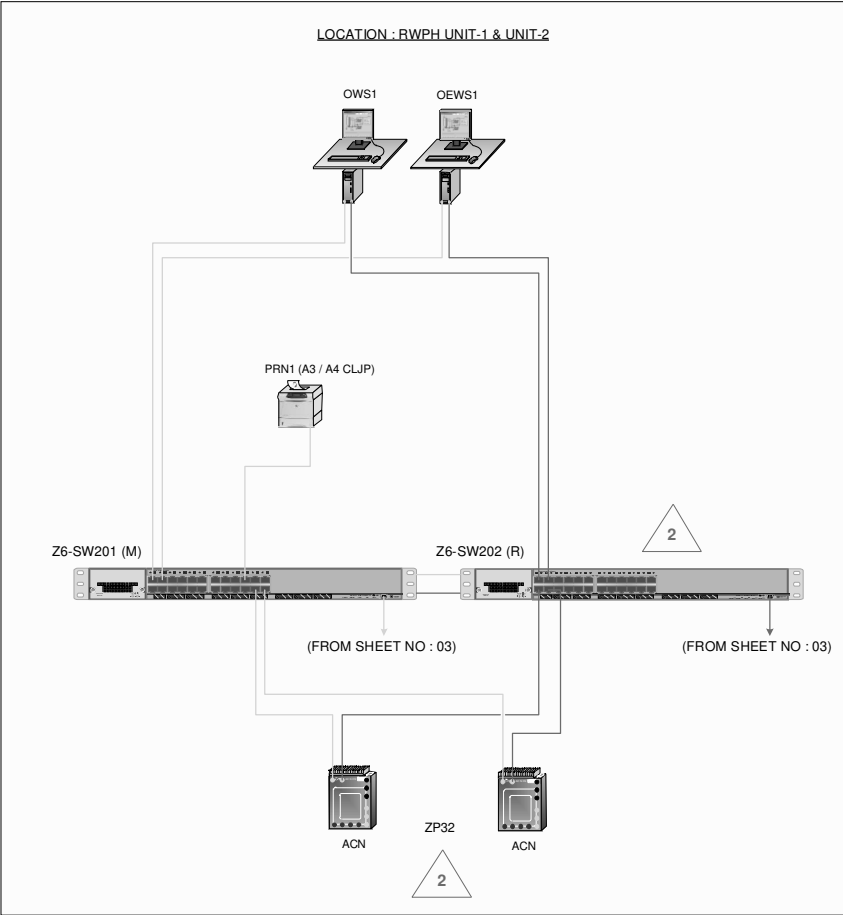
					 	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER						
						OBJECT								
						MODEL								
DATE		NAME	APPD	REVISION			REV.NBR		TITLE HMI CONFIGURATION FOR- CLWPH (LCR)					
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD				REETESH \ 01-03-2019		
FILE				APPLA										
PROD.						HMI System		DCC DRAWING ID/REV EN-DG-1276-145-4001_02 SHEET 13 (21)						

HMI CONFIGURATION FOR-CWPH (LCR)



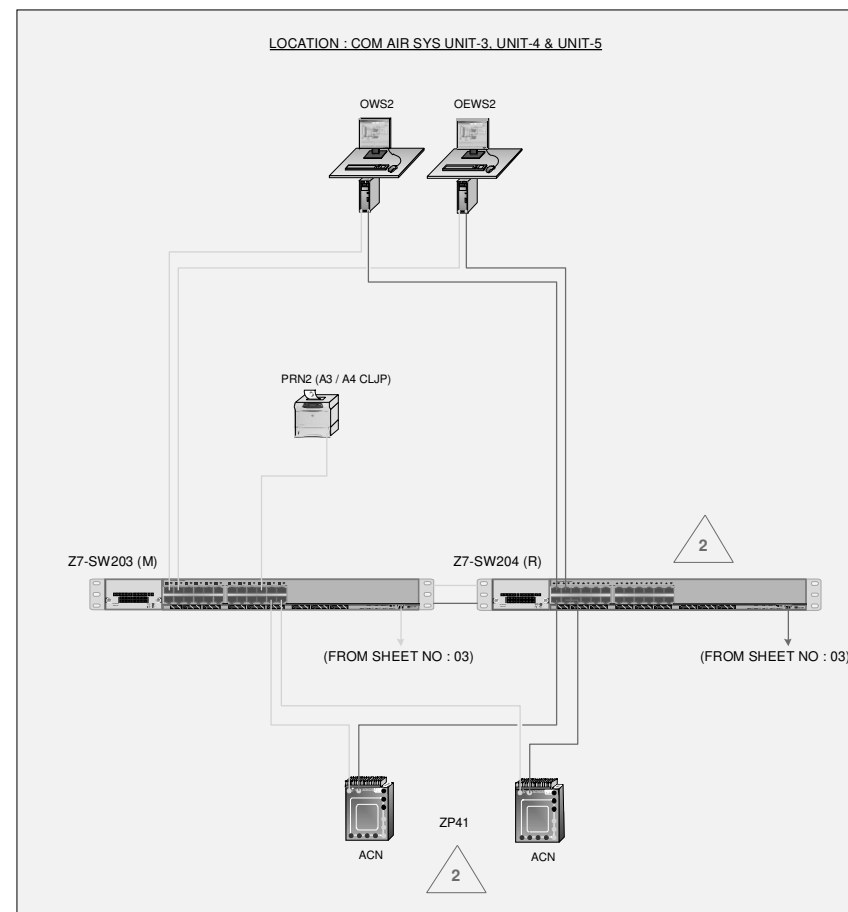
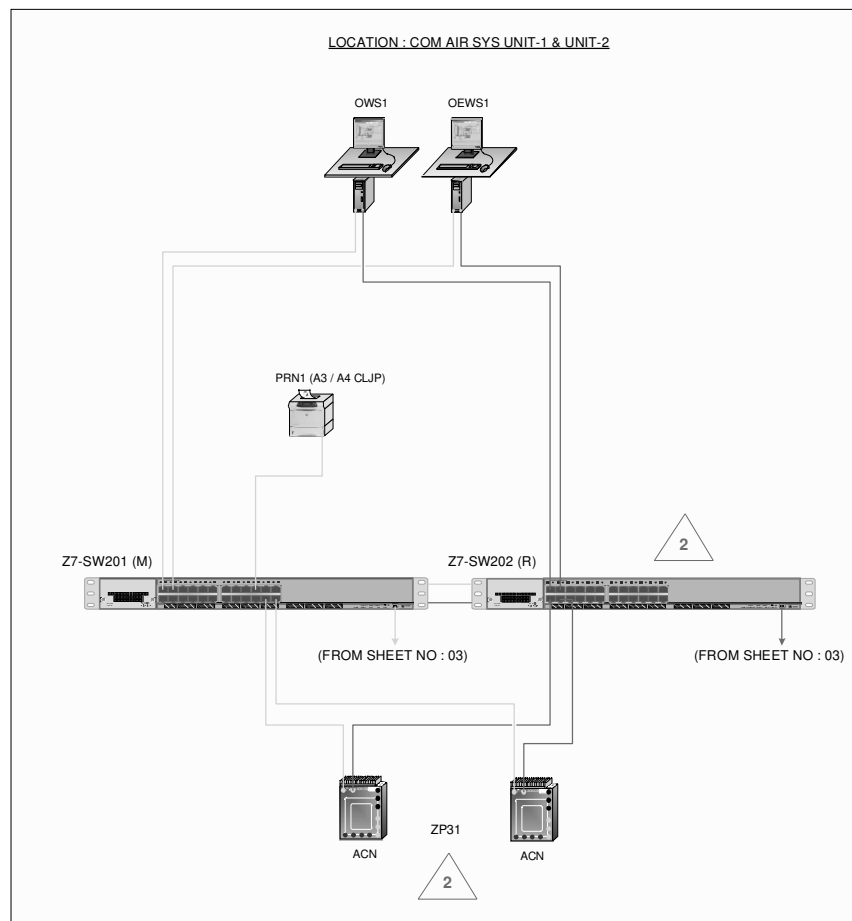
1 UNIT WISE RIO's WILL BE PROVIDED FOR CW / ACW

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



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

						Valmet बी एच ई एल BHEL	PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER										
							OBJECT													
							MODEL													
DATE		NAME	APPD	REVISION			REV.NBR	TITLE												
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019		HMI CONFIGURATION FOR-RWPH (LCR)				DCC	DRAWING ID/REV		SHEET	
FILE				APPLA				PROD.		HMI System				EN-DG-1276-145-4001		02	15 (21)			



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

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

Valmet 			PROJECT YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER	
TITLE		OBJECT		DCC	
HMI CONFIGURATION FOR- COMPRESSED AIR SYSTEM (LCR)		MODEL		DRAWING ID/REV	
PROD. HMI System				EN-DG-1276-145-4001_02	
				SHEET 16 (21)	

P. NO.		P. DATE		PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER	
C. NO.		C. DATE		OBJECT			
APPD		REVISION		MODEL			
CHKD		ABHISHEK \ 01-03-2019		TITLE		DCC	
APPD		REETESH \ 01-03-2019		HMI CONFIGURATION DIAGRAM (THIRD PARTY CONNECTIVITY DETAILS)		DRAWING ID/REV	
APPLA				PROD. HMI System		SHEET	
						EN-DG-1276-145-4001 02 19 (21)	

LEGEND :

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

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

HMI CONFIGURATION DIAGRAM

PROJECT : YADADRI TPS, NALGONDA (5 x 800 MW)
WBS No. : CE/1276-SH1-56-01
TO
CE/1276-SH5-56-01
CE/1276-SHC-56-01
BHEL DRG. No. : EN-DG-1276-145-4001

TATA CONSULTING ENGINEERS LIMITED	
VENDOR DOCUMENT REVIEW STATUS	
☒ A	Drawing/Document approved as submitted. Proceed with fabrication/construction.
☐ B	Drawing/Document approved subjected to comments noted. Proceed with fabrication/construction considering our comments.
☐ C	Our comments are noted on this marked up print.
☐ D	Our comments are noted in memo attached to the forwarding transmittal letter No. TCE11005A-IG-V01-276 Dated 27-01-2020
☐ E	Correct original of this drawing/document to reflect our comments and resubmit for approval.
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☐ G	Drawings/Documents of this category are for information only and not for approval. Information furnished on the drawing/document is noted.
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Reviewed by.....NC.....Date.....27-01-2020	

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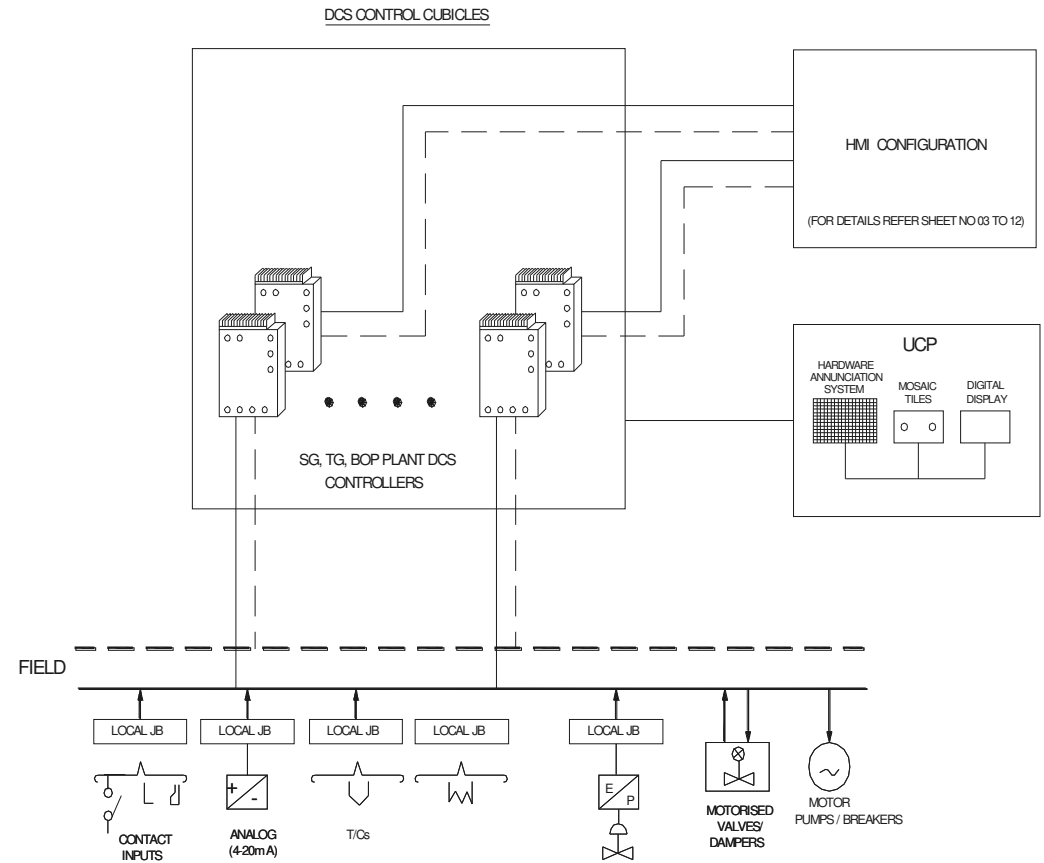
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JOB NO.	417
STATUS	CONTRACT
DISTRIBUTION	

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

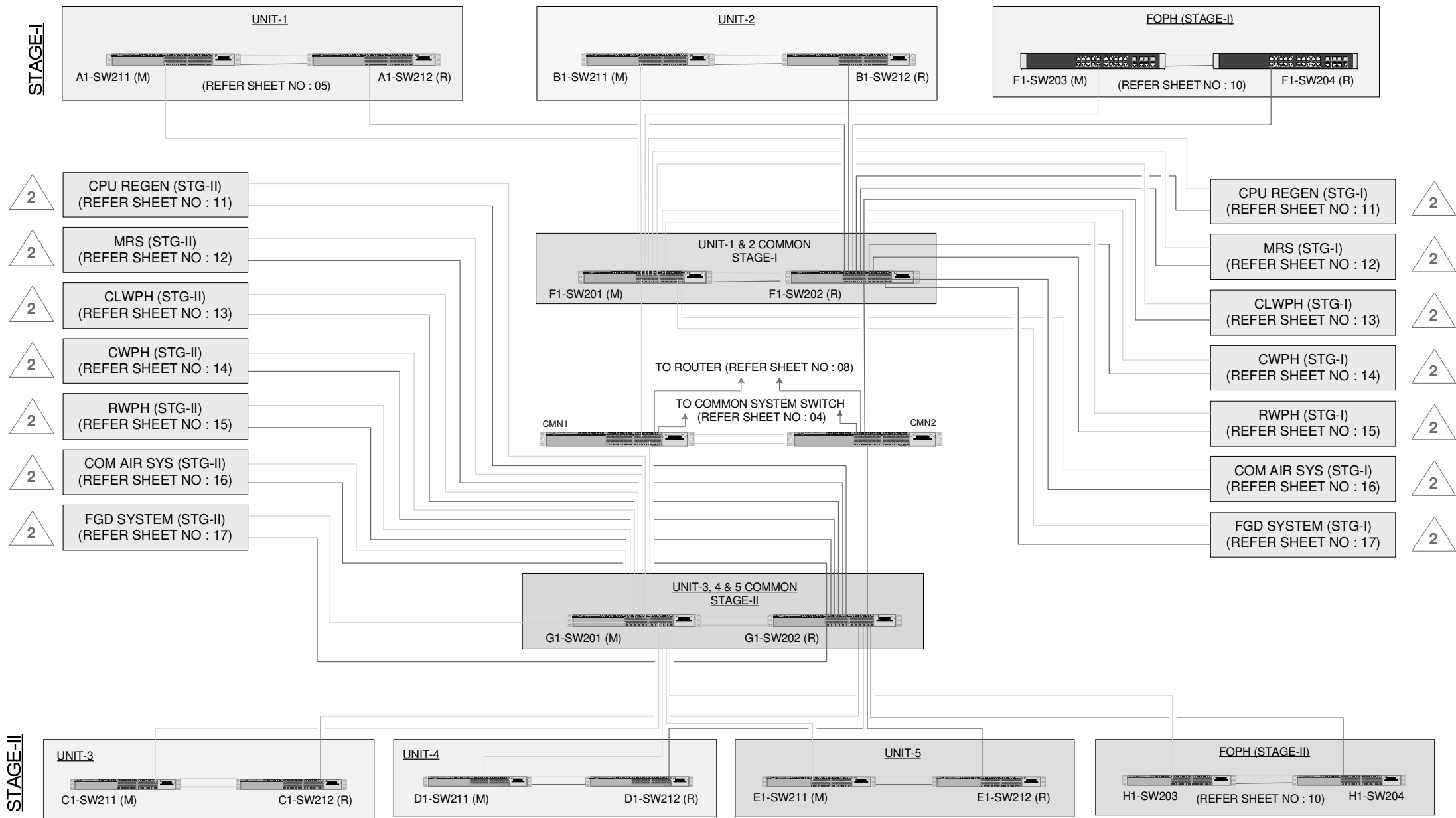
CUSTOMER	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, NALGONDA																							
CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE INDIA																							
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA						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

OVERALL DCS CONFIGURATION FOR UNIT-1 TO UNIT-5



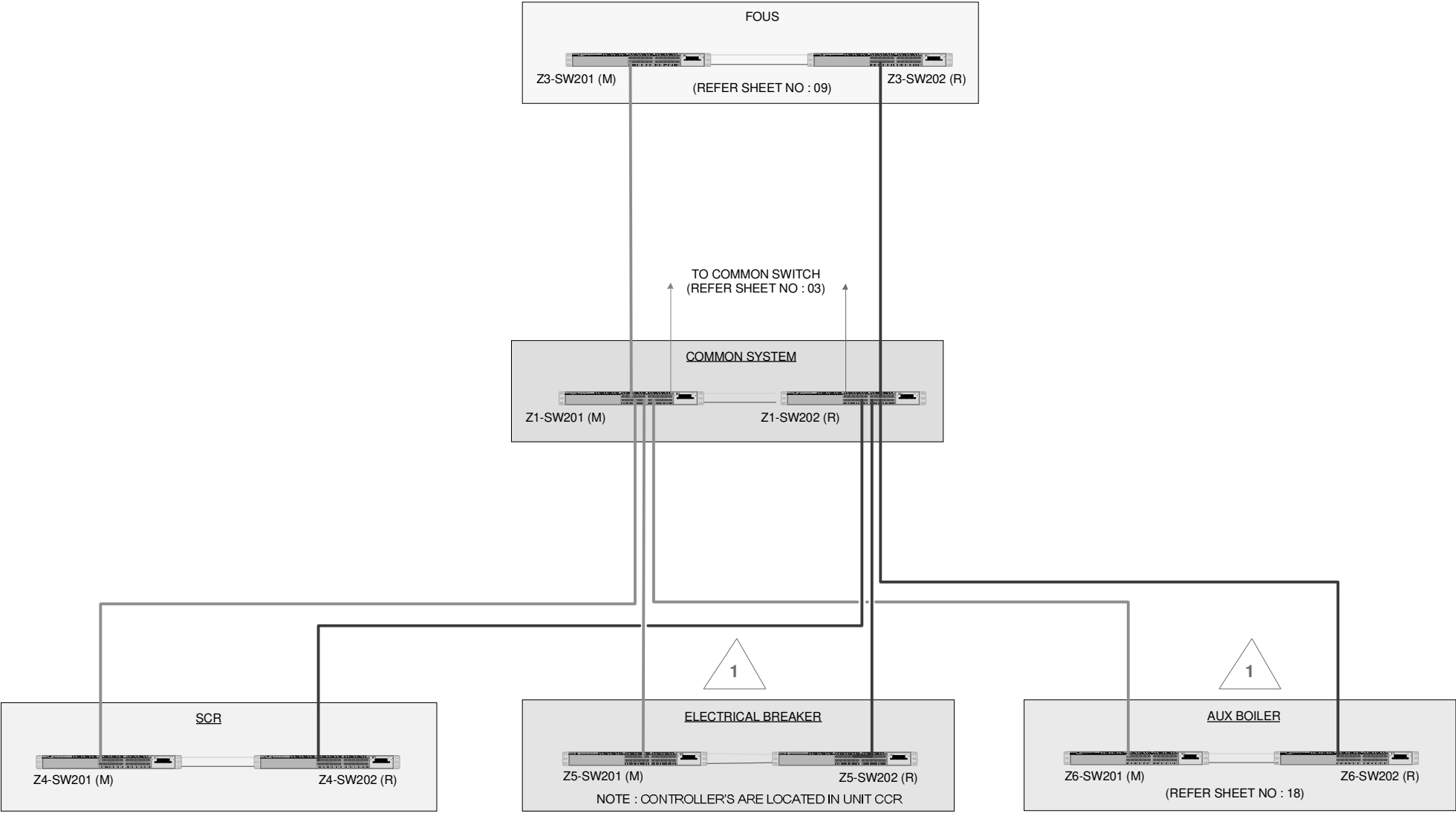
				Valmet		बी एच ई एल		PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER					
						BHEL		OBJECT							
								MODEL							
DATE		NAME	APPD	REVISION			REV.NBR		TITLE OVERALL DCS CONFIGURATION FOR UNIT-1 TO UNIT-5						
DESIGN.		BHASKAR \ 01-03-2019		CHKD	REETESH \ 01-03-2019		APPD ABHISHEK \ 01-03-2019								
FILE				APPLA			PROD. HMI System				DCC	DRAWING ID/REV EN-DG-1276-145-4001		02	SHEET 02 (21)

HMI CONFIGURATION DIAGRAM OVERVIEW



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

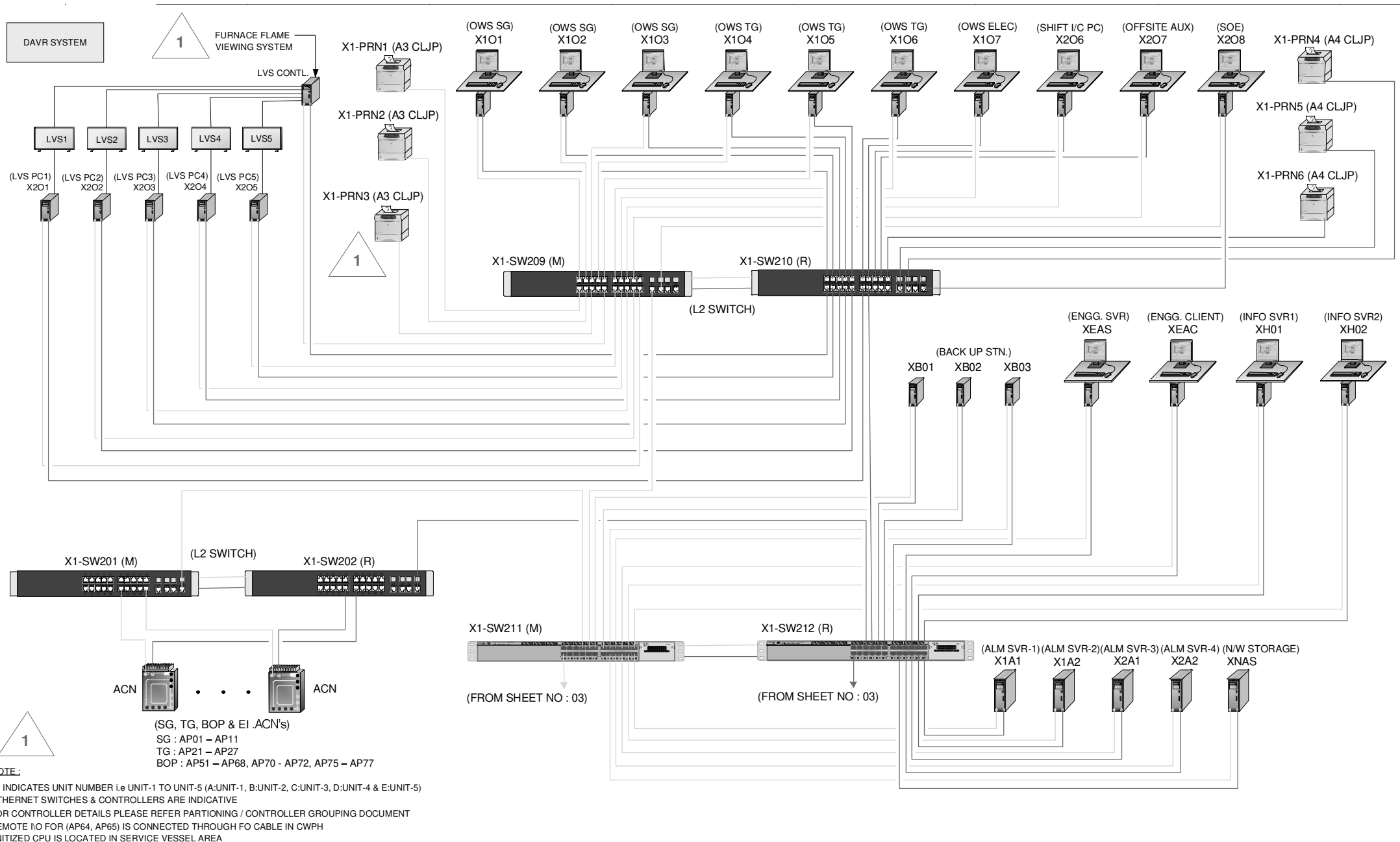
HMI CONFIGURATION DIAGRAM OVERVIEW



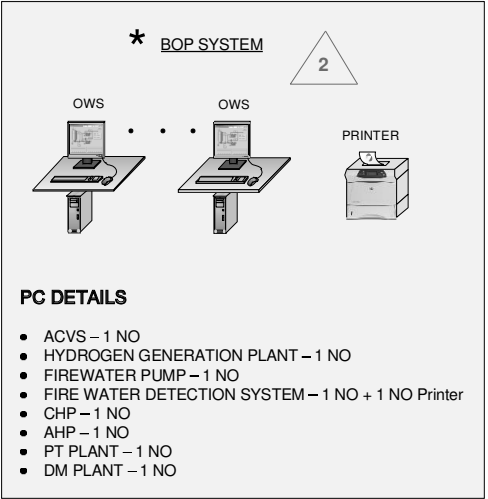
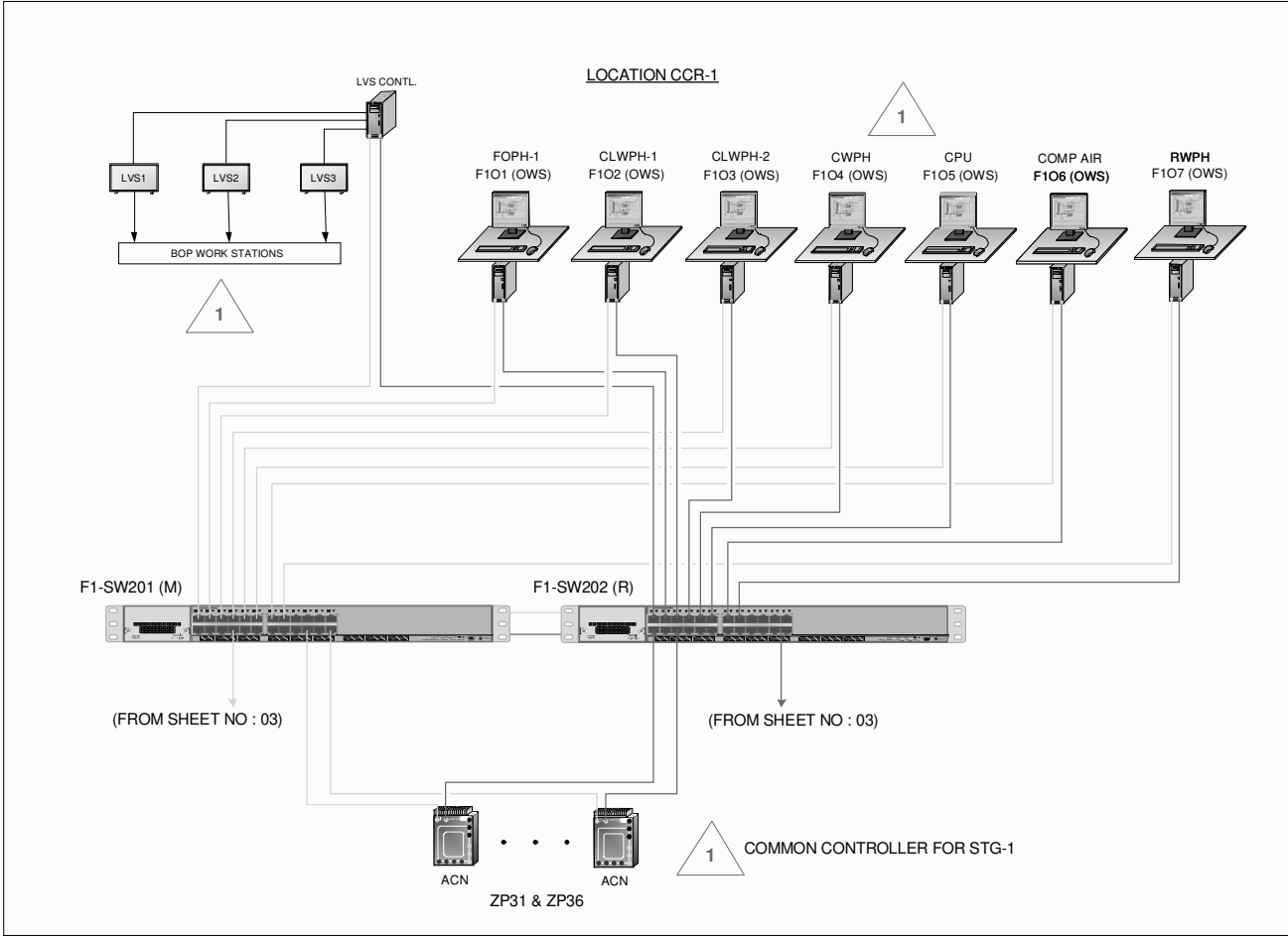
AHP & CHP REMOVED

								PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER			
								OBJECT					
								MODEL					
DATE		NAME	APPD	REVISION				REV.NBR		HMI CONFIGURATION DIAGRAM OVERVIEW			
DESIGN.		BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019					
FILE				APPLA				PROD.				HMI System	
										DCC			
										DRAWING ID/REV			
										SHEET			
										EN-DG-1276-145-4001			
										02			
										04 (21)			

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



					Valmet बी एच ई एन BHEL	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER		
						OBJECT				
						MODEL		CUSTOMER DWG NR		
DATE	NAME	APPD	REVISION			REV.NBR	TITLE			
DESIGN. BHASKAR \ 01-03-2019		CHKD ABHISHEK \ 01-03-2019	APPD REETESH \ 01-03-2019		HMI CONFIGURATION FOR UNIT-1 TO UNIT-5 - CCR		DCC	DRAWING ID/REV		SHEET
FILE			APPLA				PROD. HMI System	EN-DG-1276-145-4001		02

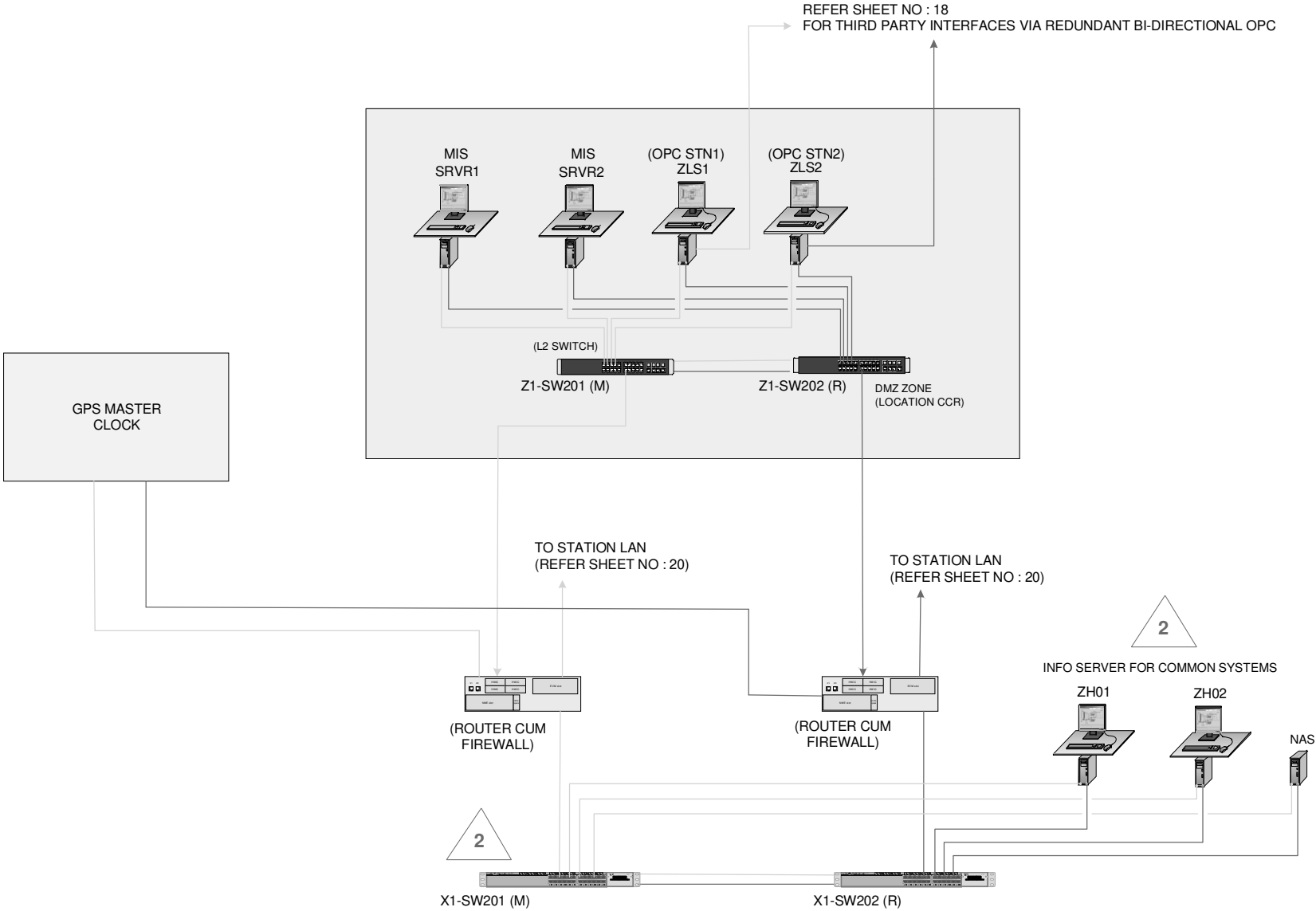


* UNDER RESPECTIVE BOP VENDOR SCOPE. HOWEVER, DESK WILL BE SUPPLIED BY BHEL-EDN

FOR CONTROLLER DETAILS PLEASE REFER PARTIONING / CONTROLLER GROUPING DOCUMENT

								PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER						
								OBJECT								
								MODEL								
DATE		NAME	APPD	REVISION				REV.NBR		TITLE						
DESIGN.		BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019								
FILE				APPLA												
						HMI CONFIGURATION (COMMON SYSTEM UNIT-1 & UNIT-2) - CCR						DCC	DRAWING ID/REV		SHEET	
						PROD.		HMI System				EN-DG-1276-145-4001		02	06 (21)	

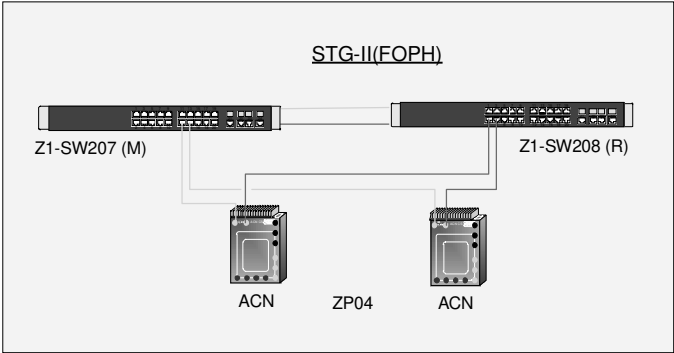
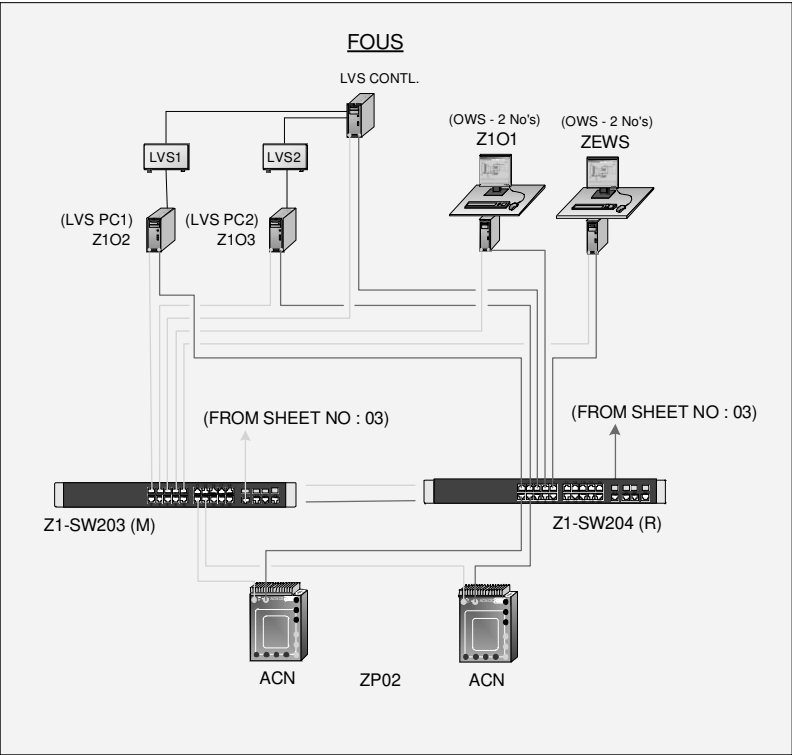
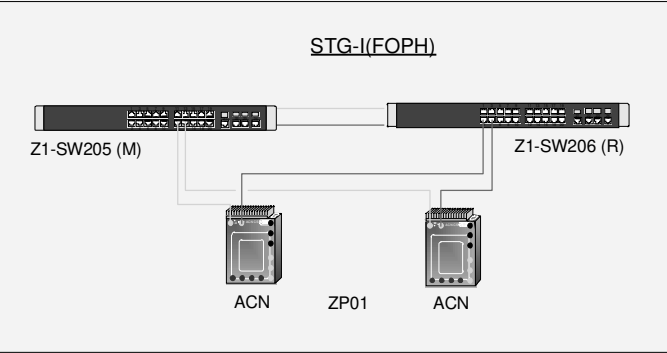
HMI CONFIGURATION COMMON FOR 5 UNITS



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

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

HMI CONFIGURATION FOR FOUS AND FOPH (LCR)

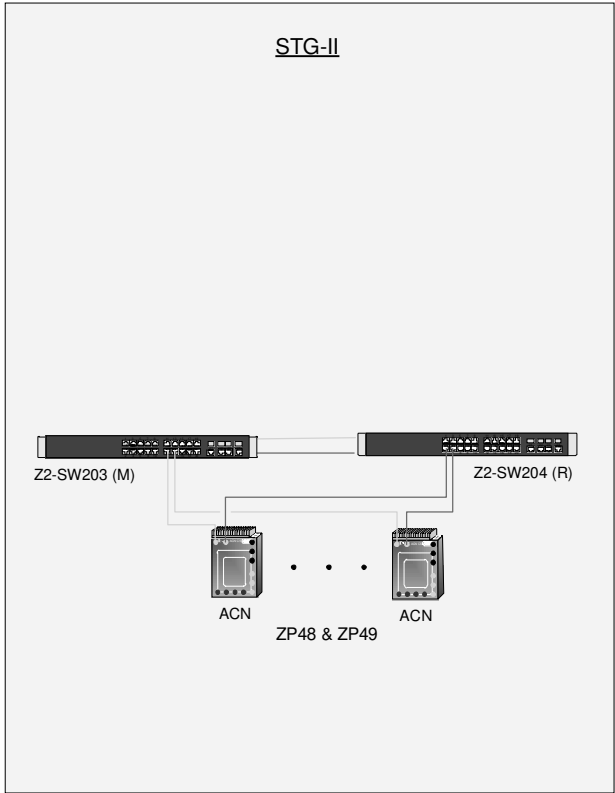
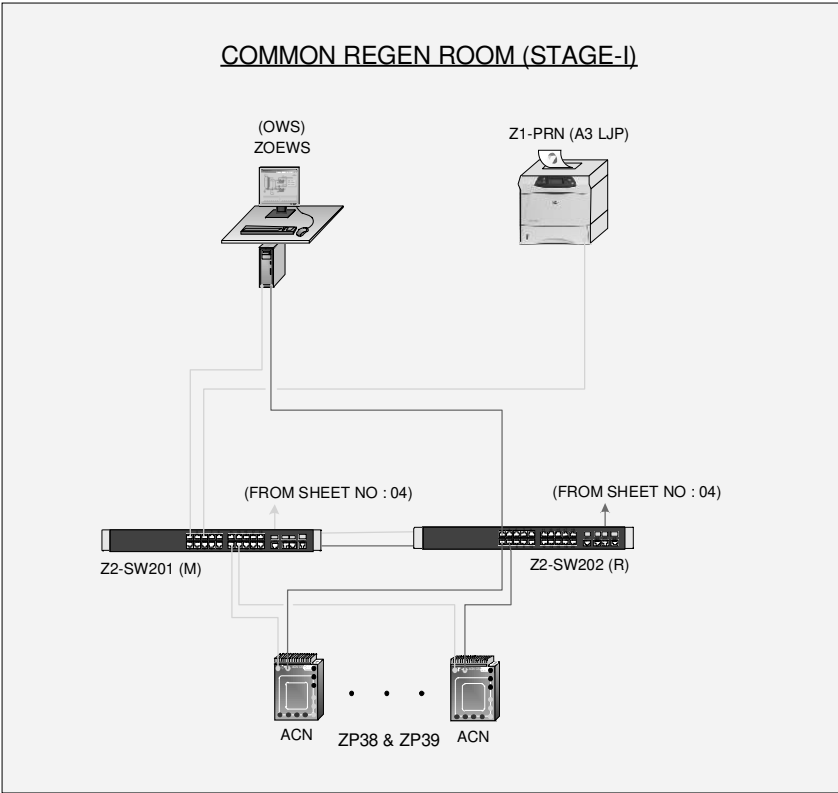


NOTE :
HFO TRUCK UNLOADING AND LDO TRUCK UNLOADING IS IN MAIN CONTROLLER WITH MIMIC AND BACKUP PANEL
#RIO AT HFO UNLOADING TRAIN AREA WILL BE CONNECTED TO ZP02 WITH MIMIC BACKUP PANEL

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

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

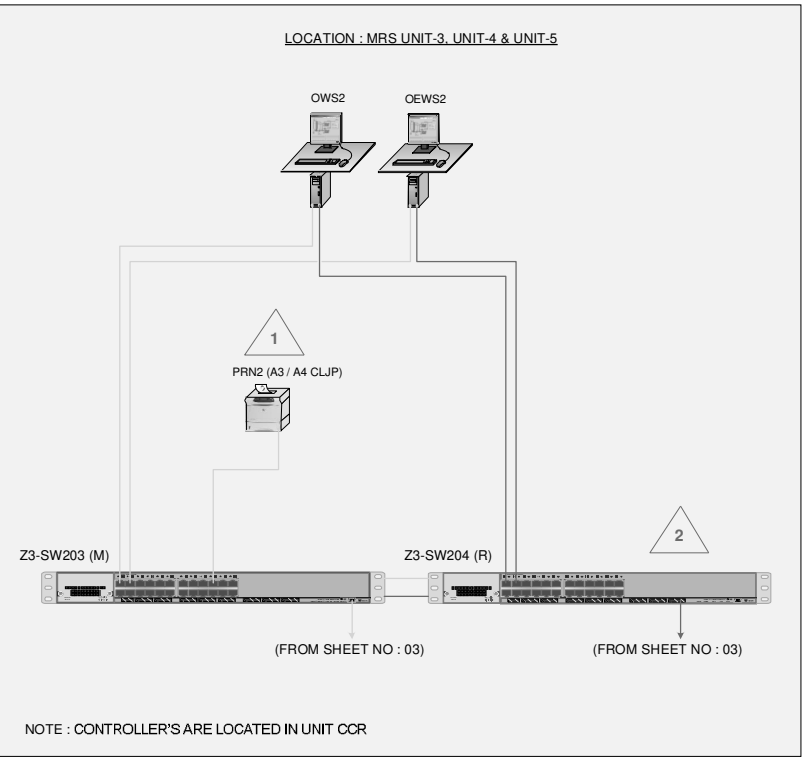
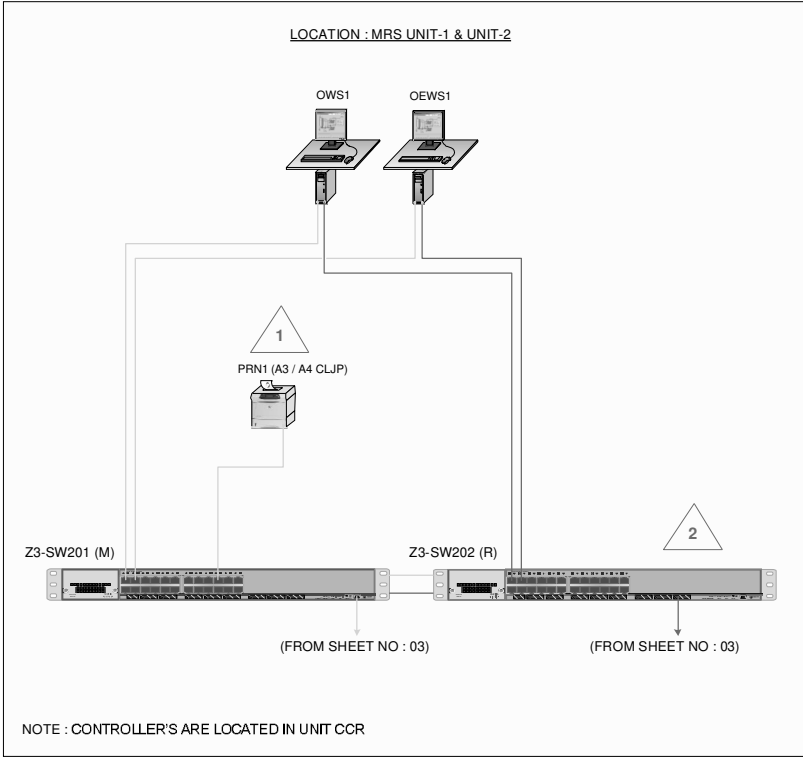
HMI CONFIGURATION FOR- COMMON REGEN ROOM (STAGE-I&II)



NOTE : UNITIZED DCS IS IN SERVICE VESSEL IN CCR

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

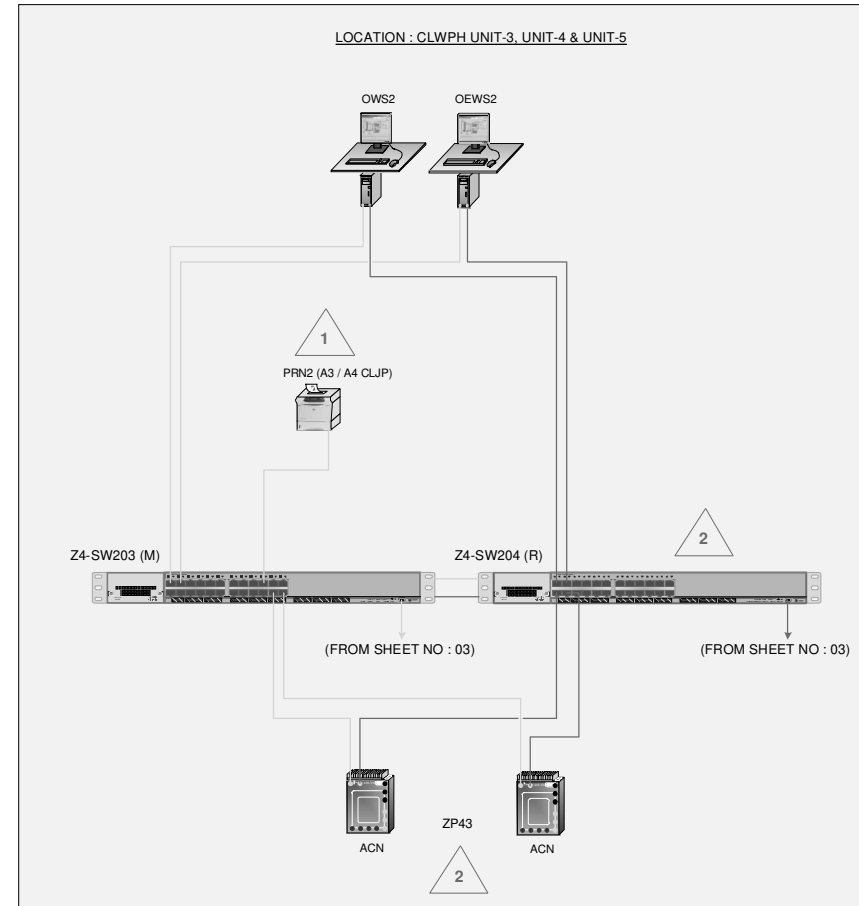
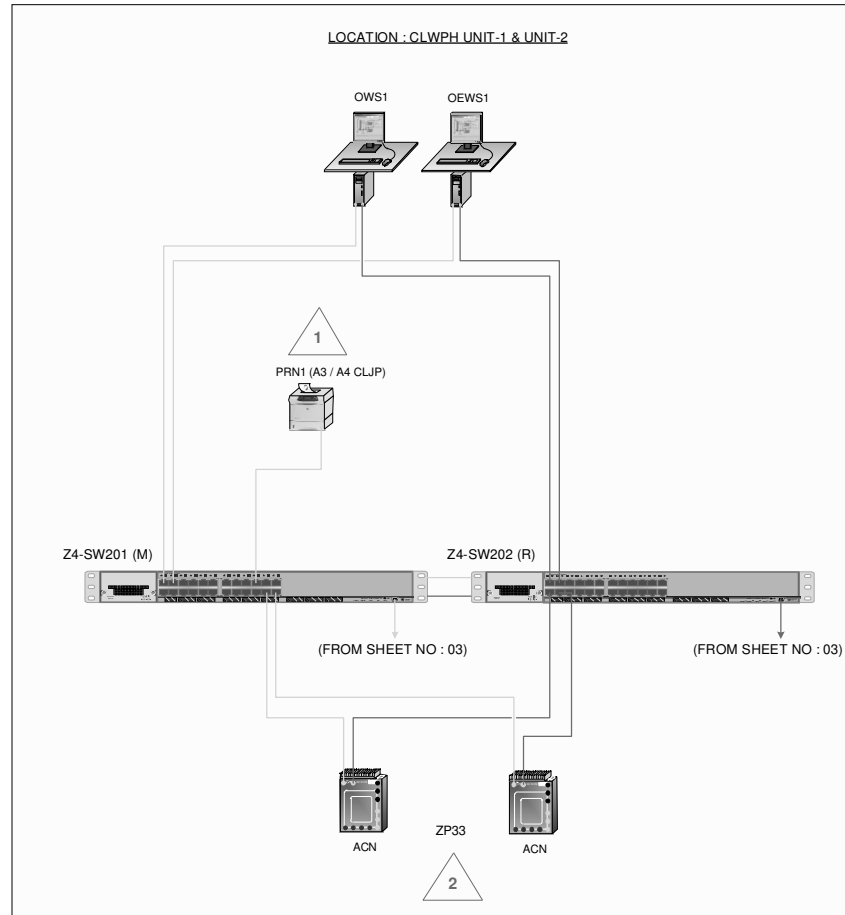
								PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER									
								OBJECT											
								MODEL											
DATE	NAME	APPD	REVISION			REV.NBR	TITLE			DCC			DRAWING ID/REV		SHEET				
DESIGN.		BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019									HMI CONFIGURATION FOR- COMMON REGEN ROOM (STAGE-II)		
FILE			APPLA			PROD.			HMI System										
										EN-DG-1276-145-4001		02	11 (21)						



1 STAGE WISE CONTROLLER WILL BE PROVIDED IN CCR

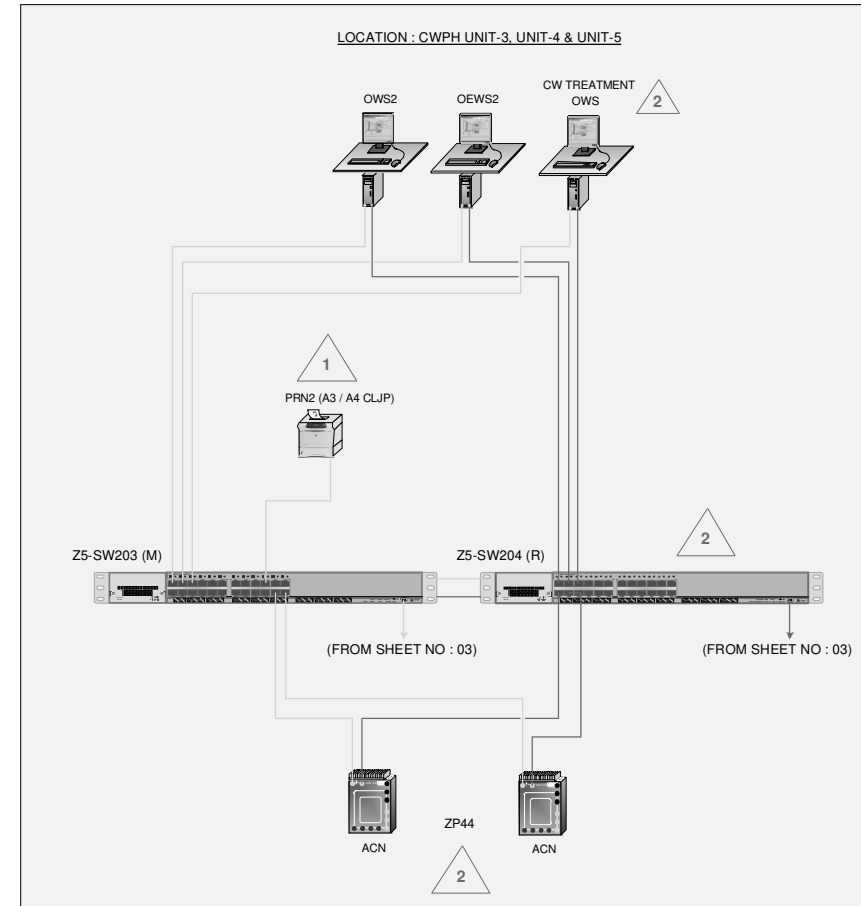
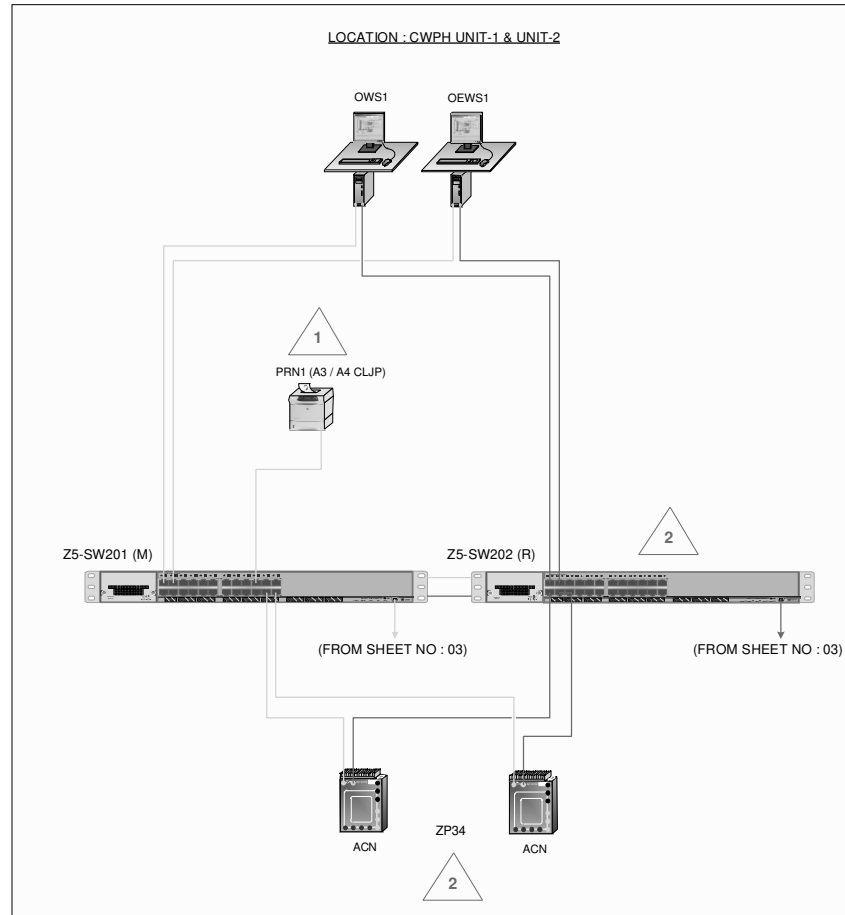
NOTE : BACKUP PANEL WITH COLOURED MIMIC, PB LAMPS, ANNUNCIATION WILL BE SUPPLIED BY BHEL EDN

								PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER					
								OBJECT							
								MODEL							
DATE				NAME				APPD							
				REVISION				REV.NBR							
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD		REETESH \ 01-03-2019					
FILE				APPLA											
				TITLE											
				HMI CONFIGURATION DIAGRAM (MRS)											
PROD.		HMI System						DCC		DRAWING ID/REV					
										EN-DG-1276-145-4001					
										02					
										SHEET					
										12 (21)					



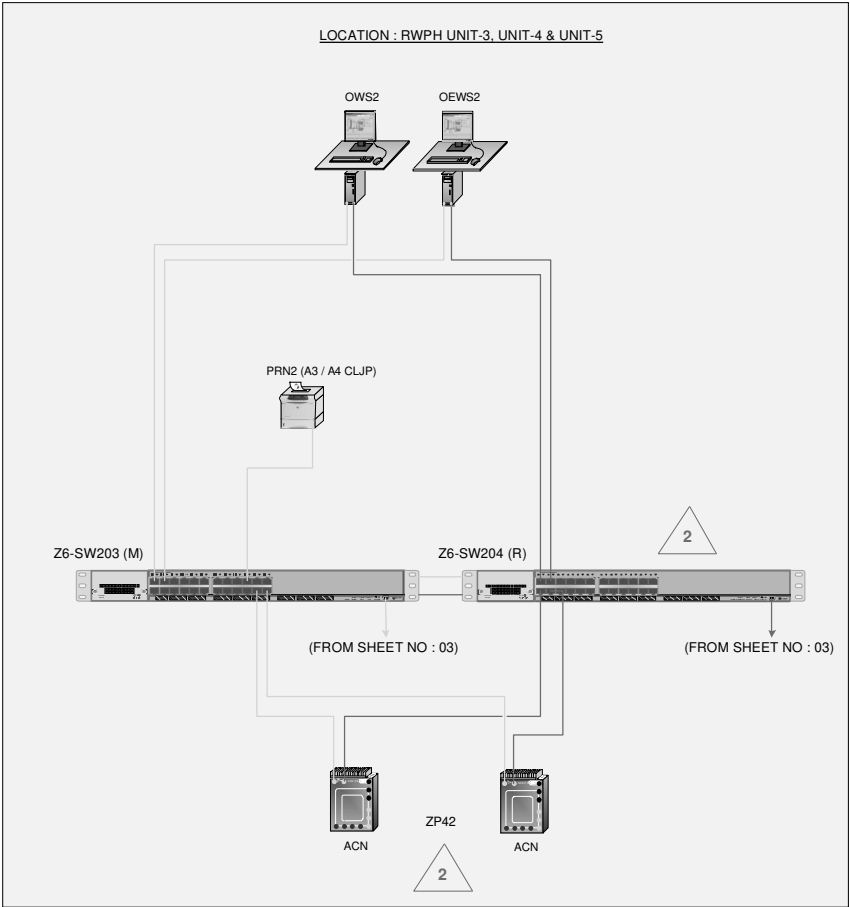
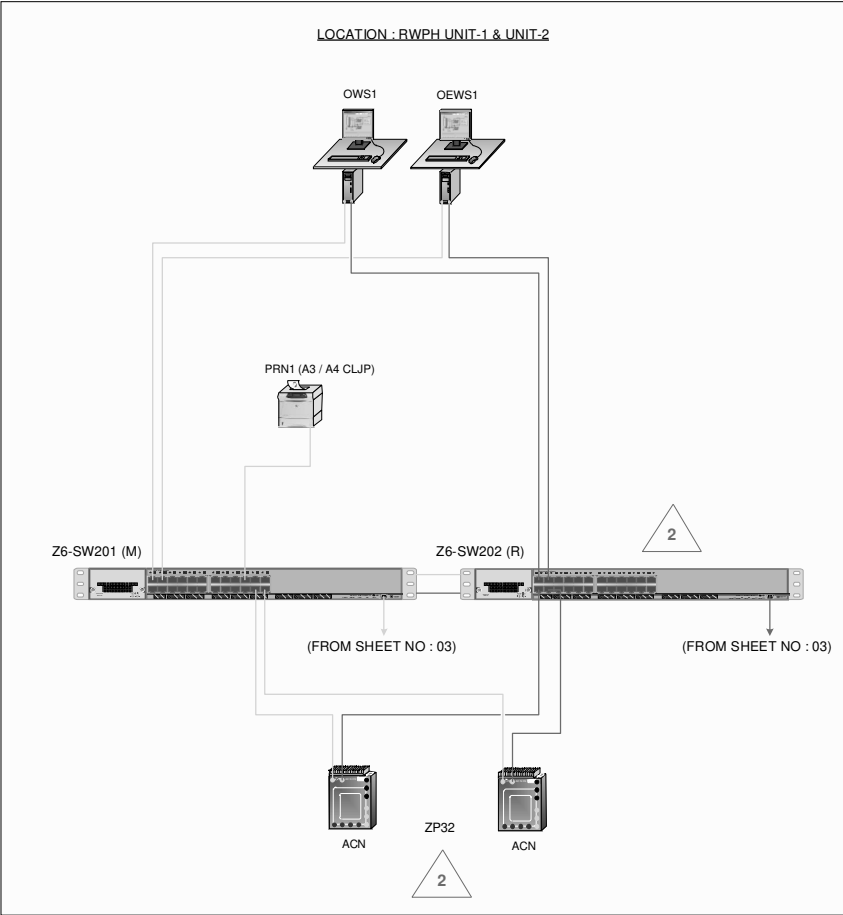
						 	PROJECT YADADRI TPS (5 x 800MW) - TSGENCO		CUSTOMER							
							OBJECT									
							MODEL									
DATE		NAME	APPD	REVISION			REV.NBR	TITLE HMI CONFIGURATION FOR- CLWPH (LCR)								
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019							APPD		REETESH \ 01-03-2019	
FILE				APPLA				PROD.		HMI System		DCC	DRAWING ID/REV		SHEET	
													EN-DG-1276-145-4001		02	13 (21)

HMI CONFIGURATION FOR-CWPH (LCR)



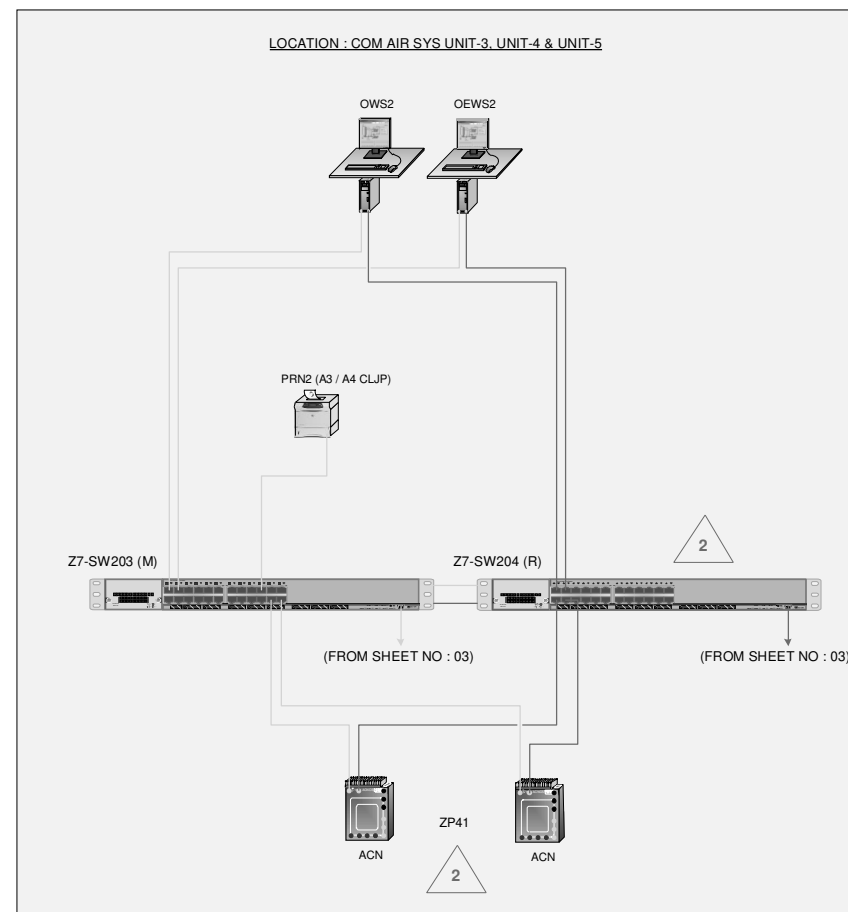
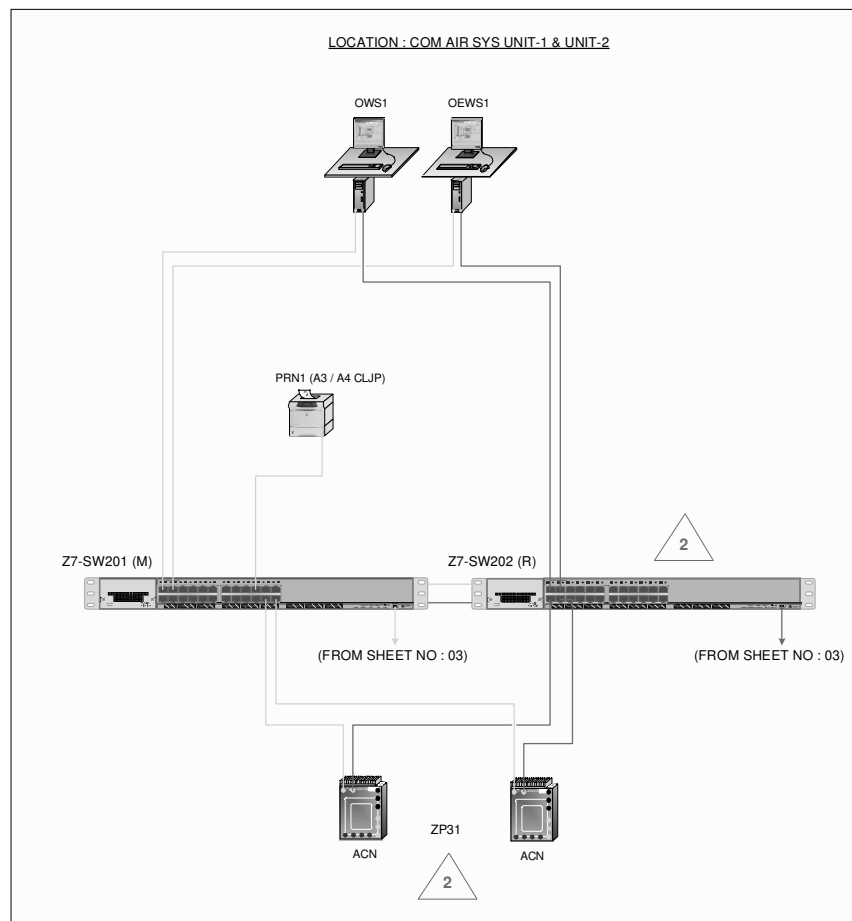
1 UNIT WISE RIO's WILL BE PROVIDED FOR CW / ACW

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



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

								PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER					
								OBJECT							
								MODEL							
DATE		NAME	APPD	REVISION			REV.NBR			TITLE HMI CONFIGURATION FOR-RWPH (LCR) PROD. HMI System					
DESIGN.		BHASKAR \ 01-03-2019		CHKD		ABHISHEK \ 01-03-2019		APPD					REETESH \ 01-03-2019		
FILE				APPLA											
										DCC	DRAWING ID/REV		SHEET		
												EN-DG-1276-145-4001		02	15 (21)

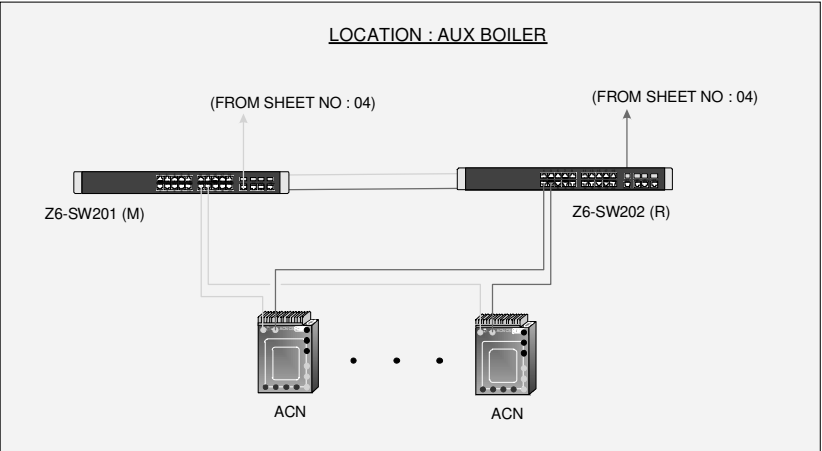


NOTE : GUI AT COMPRESSED AIR SYSTEM CONTROL ROOM WILL BE SUPPLIED BY BOP VENDOR

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

HMI CONFIGURATION FOR - AUX BOILER

1



								PROJECT YADADRI TPS (5 x 800MW) - TSGENCO	CUSTOMER			
								OBJECT				
								MODEL				
DATE	NAME	APPD	REVISION			REV.NBR		TITLE				
DESIGN.	BHASKAR \ 01-03-2019		CHKD	ABHISHEK \ 01-03-2019		APPD	REETESH \ 01-03-2019		HMI CONFIGURATION DIAGRAM (AUX BOILER)			
FILE				APPLA		PROD.		HMI System		DCC	DRAWING ID/REV	SHEET
										EN-DG-1276-145-4001 02		18 (21)

C PROTOCOL			
APPD	REVISION		REV.NBR
CHKD	ABHISHEK \ 01-03-2019	APPD	REETESH \ 01-03-2019
APPLA			

Valmet	बी एच ई एन BHEL	PROJECT	YADADRI TPS (5 x 800MW) - TSGENCO			CUSTOMER			
		OBJECT							
		MODEL							
TITLE						DCC	DRAWING ID/REV	SHEET	
HMI CONFIGURATION DIAGRAM (THIRD PARTY CONNECTIVITY DETAILS)									
PROD.	HMI System						EN-DG-1276-145-4001	02	19 (21)

LEGEND :

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

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

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

1.00.00 GENERAL

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

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

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

2.00.00 CODES AND STANDARDS

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

3.00.00 DESIGN AND CONSTRUCTION REQUIREMENTS

3.01.00 DEAD WEIGHT TESTER - (2 NOS.)

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

- 3.01.02 The following accessories shall be included :

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.04.00 INCLINED TUBE MANOMETER - (2 NOS.)

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

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

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

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

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

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

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

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

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

3.09.00 DECADE RESISTANCE BOX - (2 NOS.)

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

3.09.02 A dial type resistance box shall be supplied. Range of resistance box shall typically be 0.01 ohm to 111.11111 K ohms. There shall be eight dials, each dial providing one decade of resistance value. The resistance coils should be made of manganin, non inductivity wound and aged resistors with low temperature coefficient and low contact resistance steps. The ends of the coils should be soldered to the terminal blocks with silver solder. The direct-reading accuracy of the resistance box shall be $\pm 2\%$ for 0.01 decade, $\pm 0.3\%$ for 0.1 decade, $\pm 0.05\%$ for 1,10,100,1K, 10K decades and $\pm 0.5\%$ for 100K decade . All resistors shall be temperature compensated.

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

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

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

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

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

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

3.11.00 SIGNAL GENERATOR – (2 NOS.)

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

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

meters

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

Power supply shall be short circuit proof and crowbar protected.

3.15.00 STOP WATCH – (2 NOS)

3.15.01 Digital Type

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

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

3.15.02 Mechanical Type

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

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

3.16.00 CONTINUITY TESTER -(10 NOS.)

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

3.17.00 TONG TESTER – (3 NOS.)

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

3.18.00 HIGH RANGE TONG TESTER – (1 NOS.)

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

3.19.00 STABILISED POWER SUPPLY – (2 NOS.)

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

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

3.20.00 TEMPERATURE CONTROLLED BATH - (1 NO.)

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

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

3.21.00 TEMPERATURE CALIBRATOR – (3 NOS.)

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

3.22.00 **TEMPERATURE CALIBRATOR – TABLE MOUNTED (2 NOS.)**

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

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

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

3.23.00 **HOT AIR BLOWER – (1 NO.)**

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

3.24.00 **STROBOSCOPE –(1 NO.)**

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

3.25.00 **PORTABLE TREND RECORDER - (1 NO.)**

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

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

3.26.00 **BAROMETER – (1 NO.)**

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

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

3.27.00 SURFACE PYROMETER– (2 NOS.)

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

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

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

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

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

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

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

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

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

3.29.00 PORTABLE DIGITAL MULTIMETER - (10 NOS.)

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

3.30.00 PORTABLE VACUUM TESTER (2 NOS.)

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

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

3.30.02 It shall have the following features and specification:

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

3.31.00 FIELD TRANSMITTER CALIBRATOR - (2 NOS.)

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

3.31.02 Field Transmitter Calibrators shall have following features:

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

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

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

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

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

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

CO:0-1000 PPM

O₂ : 0-25% by volume

NO:0-100 ppm

SO₂ : 0-1000 ppm

HC:0-100% LEL

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

3.34.00 SOLDERING IRON WITH SOLDER SUCKER (8 SETS)

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

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

3.35.00 DESOLDERING STATION (1 SET)

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

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

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

3.38.04 Accessories.

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

3.39.00 **FURNACE (1 NO.)**

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

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

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

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

Ranges :

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

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

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

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

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

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

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

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

3.44.00 SUPPRESSED RANGE MERCURY IN GLASS THERMOMETER (2 SET)

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

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

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

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

3.46.00 RHEOSTATS (1 SET.)

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

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

3.47.00 DESKTOP DIGITAL MULTIMETER - (2 NOS.)

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

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

3.48.00 PHASE SEQUENCE METER - (1 NO)

Electronic type

3.49.00 FREQUENCY METER – (1NO.)

Electronic type

3.50.00 MINISCOPE METER – (1NO.)

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

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

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

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

3.52.00 TOOL KIT BOX– (12NOS.)

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

3.53.00 WORK BENCH – (2 NOS.)

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

3.54.00 INSTRUMENT RACK – (2 NOS.)

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

3.55.00 PORTABLE PH CALIBRATOR – (2 NOS.)

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

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

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

3.56.00 OIL CONDITION MONITOR– (1 NO.)

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

3.57.00 PORTABLE ULTRASONIC FLOW METER -(1 NO.)

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

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

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

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

3.59.00 ANEROID BAROMETER - (1 NO.)

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

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

3.60.00 FLOW METER CALIBRATOR - (1 NO.)

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

3.61.00 AIR SET -(1 NO.)

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

3.62.00 MODULE TESTER -(1 NO.)

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

3.63.00 DC REGULATED POWER SOURCE -(2 NOS.)

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

3.64.00 WELDING MACHINE -(1 NO.)

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

04. Accessories : Electrode cable

3.65.00 JEWELLERS LATHE -(1 NO.)

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

3.66.00 GRINDING MACHINE -(1 NO.)

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

3.67.00 FEELER GAUGE - (1 NO.)

01. Type : Sets of feeler of different size

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

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

3.69.00 PORTABLE DRILLING MACHINE - (1 NO.)

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

3.70.00 AUTO TRANSFORMER - (1 NO.)

01. Capacity : 15A, 8A

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

3.71.00 UNIVERSAL DIGITAL THERMOMETER - (1 NO.)

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

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

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

3.73.00 NICKEL CADMIUM CELL - (1 NO.)

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

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

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

(ii) 0 to 20 Bar (Hydraulic type)

(iii) 0 to 200 Bar (Hydraulic type)

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

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

[A] Bench Vice

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

[B] Hand Vice

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

3.76.00 VACUUM CLEANER - (1 NO.)

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

3.77.00 INFRARED PYROMETER - (1 NO.)

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

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

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

3.79.00 COMPUTERISED CALIBRATION SYSTEM - (1 NO.)

This shall be located on test bench.

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

3.80.00 SCREW GAUGE - (1 NO.)

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

3.81.00 SCANNER - (1 NO.)

- 01. Type : Electronic

3.82.00 GRINDING WHEEL - (5 NO.)

- 01. Type : Abrasive type

3.83.00 TORXIMETER - (2 NO.)

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

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

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

3.84.00 PITOT TUBE - (2 NO.)

01. Material : Stainless Steel

3.85.00 LAPTOP - (2 NO.)

01. Processor : Latest or Core i5 (min)

02. RAM : 2 GB (min)

03. Hard Drive : 1 TB

04. Multimedia Drive : DVD+/-RW

05. Display : 15.6"

06. Network Card : Yes

07. Keyboard : Yes

08. Pointing Device : Touch pad

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

10. Operating System : Latest available version

11. Software : Liscenced version of all necessary software

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

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

01. No of channel : 2 Analog+1 Auxiliary

02. Continuous battery operation : Up to 12 hour

03. PC Communication Interface : USB

04. Display : LCD

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

3.87.00 PORTABLE mA CALIBRATOR – (3 NO.)

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

3.88.00 TABLE MOUNTED mA CALIBRATOR – (2NO.)

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

3.89.00 PORTABLE mV CALIBRATOR – (2NO.)

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

05. Preferred feature : Reference junction compensation for thermocouple, over voltage/ current protection

06. Accessories : Test lead, rechargeable battery with battery charger, carrying case etc

3.90.00 TEST RTD – (2NO.)

01. Sensor type : Platinum resistance

02. Temperature : 0-600°C

03. Accessories : Cable, carrying case etc

3.91.00 TEST THERMOCOUPLE – (2NO.)

01. Sensor type : All type of thermocouple

02. Temperature : 0-1200°C

03. Accessories : Cable, carrying case etc

3.92.00 FREQUENCY COUNTER/ TIMER – (1NO.)

01. Bandwidth : 350 MHz

02. Display : 12 digit

03. Temperature : 0-50°C

04. Accessories : Battery with battery charger, carrying case etc

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 version)	15	68610.00	65280.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	31880.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	19920.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	28690.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	30130.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	25110.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	34580.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	14390.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18050.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	15940.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	20720.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10360.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	12750.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10420.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10200.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8440.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9560.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9560.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5210.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	5880.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5150.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4230.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	2910.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2180.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2180.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	680.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	370.00

Annexure**C1**

DATE:31/08/2021

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	650.00	640.00
31	FORK LIFT 3T	5	540.00	530.00

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	27230.00	27230.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12160.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	59520.00
4	PORTAL CRANE, 360T	15	15630.00	14880.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	58630.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	72540.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	35420.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	22140.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	31880.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	33480.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	27900.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	38420.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	15990.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20060.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	17710.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	23020.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	11510.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14170.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11580.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11330.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9380.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	10620.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	10620.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5790.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6540.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5720.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4700.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3240.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2430.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2430.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	760.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	410.00

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	720.00	710.00
31	FORK LIFT 3T	5	600.00	590.00

**RATES FOR INTER REGIONAL HIRE CHARGES FOR CRANES OF CAPACITY
75 TON OR MORE FOR PERIOD 01-09-2021 TO 31-08-2023**

		Dt : 31/08/2021
SL NO.	ITEM DESCRIPTION	Rates (Rs./MONTH) valid from 01/09/2021 to 31/8/2023
I .	CRANES : -	
1	Portal Gantry Crane 500T	1243192
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	631183
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	2717358
4	PORTAL CRANE, 360T	679333
5	600MT Class Crawler Crane- Manitowoc Model 18000- <u>UPGRADED</u>	2676917
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Ungraded version)	3311783
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	1617475
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	1010917
9	MANITOWOC M-250T TRUCK CRANE	1455725
10	270 MT Class Crawler Crane- Manitowoc Model 2250	1528508
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	1273758
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	1754150
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	730283
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	915892
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	808733
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	1051358
15	CRAWLER CRANE SUMITOMO, 150T	525675
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	646983
17	CRAWLER CRANE, 120 T Fushun Model QUY120	601125
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	517592
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	428625
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	485242
20	CRAWLER CRANE 100 T (KH 500)	485242
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	300558
22	ROUGH TERRAIN CRANE 75T (RT880)	321758
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	281533

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m ³ /Hr)	1160
22	Air Blower (Flow: 20000 m ³ /Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB DIAGNOSTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3230
59	PMI Machine OLYMPUS make	3350
60	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	430

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360
96	Plasma Cutting Machine (With complete accessories)	310
97	JCB make DG Set 80 KVA	670
98	Diesel Generating Set 82.5 KVA	610
99	Portable Jacking Oil Pump	1080
100	Alloy Analyser	1770

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL 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

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

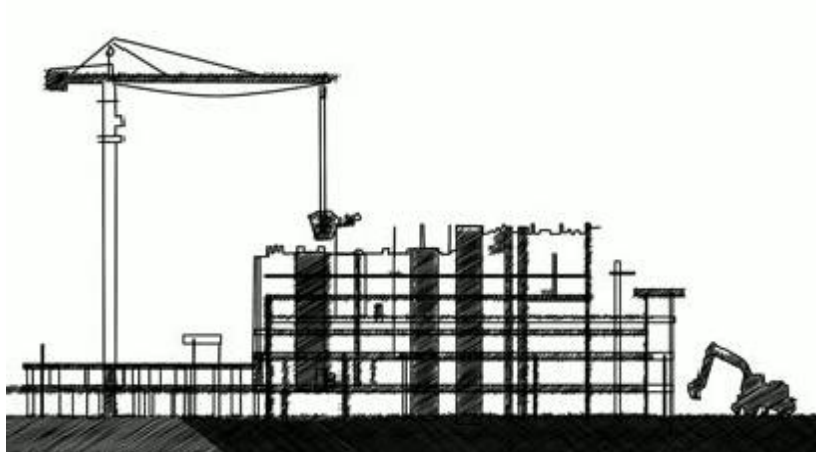
SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m³/Hr)	1290
22	Air Blower (Flow: 20000 m³/Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGNOSTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast - 9 metres (4X400 W)	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	510
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500

**RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS
ETC. FOR OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400
96	Plasma Cutting Machine (With complete accessories)	340
97	JCB make DG Set 80 KVA	740
98	Diesel Generating Set 82.5 KVA	680
99	Portable Jacking Oil Pump	1200
100	Alloy Analyser	1970



HEALTH, SAFETY and ENVIRONMENT PLAN

for

**SITE
OPERATIONS**

by

**SUB-
CONTRACTORS**

POWER SECTOR

HSE PLAN FOR SITE OPERATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START	SIGNING OF MOU	
	Agree to comply to HSE requirement- Statutory and BHEL's	Agree to accept BHEL's decision on release of 1.5% (as specified in the contract) of Gross bill amount or part thereof or otherwise(non-release), based on our HSE performance as evaluated by BHEL during the execution period
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 INFRASTRUCTURE	
	- PPEs - Drinking Water - Washing Facilities - Latrines and Urinals - Provision of shelter for rest - Medical facilities	- Canteen facilities - Labour Colony - Emergency Vehicle - Pest Control - Scrapyard - Illumination
TRAIN	HSE TRAINING , AWARENESS & PROMOTION	
	Training - Induction training - Height work and other critical areas - Tool Box talk & Pep Talk	Awareness & Promotion - Signage - Poster - Banner - Competition - Awards
COMMUNICATE	HSE COMMUNICATION	
	Incident Reporting - Accident- Fatal & Major - Property damage - Near Miss	Event Reporting - Celebrations - Training - Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 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.



**HEALTH, SAFETY AND ENVIRONMENT
PLAN FOR
SITE OPERATION by SUBCONTRACTORS**

POWER SECTOR

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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.



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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

Power Sector HSE Policy

We, at BHEL Power Sector, reaffirm our belief that the Health and Safety of our stakeholders and conservation of Environment is of utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- ✓ Ensure total compliance with applicable legislation, regulations and other requirements concerning Occupational Health, Safety and Environment.
- ✓ Ensure continual improvement in the Occupational Health, Safety and Environment Management System performance.
- ✓ Enhance Occupational Health, Safety and Environment awareness amongst employees, customers and suppliers by proactive communication and training.
- ✓ Review periodically and improve Occupational Health, Safety and Environment Management System to ensure its continuing suitability, adequacy and effectiveness in a continuously changing business environment.
- ✓ Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees to fulfill their Health, Safety and Environmental obligations.
- ✓ Incorporate appropriate Occupational Health, Safety and Environmental criteria into business decisions for selection of plant, technology and services as well as appointment of key personnel.
- ✓ Ensure availability at all times of appropriate resources to fully implement the Occupational Health, Safety and Environmental policy of the company.

This policy will be communicated to all employees and made available to interested parties.

Sd/-

Date: 01.05.2013

Director (Power)



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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:



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6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

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

6.1.2 NEAR MISS

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

6.1.3 MAN-HOURS WORKED

The total number of man hours worked by all employees including 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.



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Reportable Cases:

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

Injury Cases:

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

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

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

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

6.1.9 SEVERITY RATE

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

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

6.1.10 INCIDENCE RATE

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

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

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



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2	Safety-Steward/ Supervisor	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.



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- ☐ Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good 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



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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.
 - Aircompressors.
 - 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.



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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.



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- 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.



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8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

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

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

8.4.5.2 FIRST AIDER

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

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

- The 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



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

8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project 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:



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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	300
	rough measurements etc.	
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)



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- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending 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



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

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

9.5.1 Display of HSE posters and banners

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

9.5.2 Display of HSE signage

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

9.5.3 Competition on HSE and award

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

9.5.4 HSE awareness programme

- 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



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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



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

11.2 WORK PERMIT SYSTEM

- ☐ The following activities shall come under Work Permit System
 - a. Height working above 2 metres
 - b. Hot working at height
 - c. Confined space
 - d. Radiography
 - e. Excavation more than 4 meter depth
 - f. Heavy lifting above 50 tonRefer 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.



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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 and 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.



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- 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 than 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 savor, 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.



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- 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.



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- 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



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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.

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11.6.3 SEGREGATION

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

11.6.4 DISPOSAL

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

11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded 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



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- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and 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



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11.7.4 DAILY CHECK BY DRIVER

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



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- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box 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.



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12.3 INSPECTION OF T&Ps

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

12.4 INSPECTION OF CRANES AND WINCHES

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



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

12.7 INSPECTION 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 by BHEL as per Format No. HSEP:14-F33.

Only if the bidder qualifies the 'HSE Compliance Criteria' then bidder shall be eligible for further assessment on other parameters.

Average score of last 6 months for 'HSE Compliance Criteria' for a bidder shall be worked out and Minimum Average Score of last 6 months for a bidder to qualify for future tenders shall be 60. For new vendors (whose past record in Online HSE Evaluation System is not available with BHEL), this criterion shall not be applicable.

Note: This criterion shall be subject to review by BHEL from time to time as per requirement/ prevailing conditions.

- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen.
- 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.

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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.



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

16. 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 Slings properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

• Legend:-

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

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The 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.



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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



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



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20.0 ANNEXURES

ANNEXURE 01

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

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

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

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

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

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



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

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



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ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT: _____

SUBCONTRACTOR: _____

DATE : _____

OWNER : _____

INSPECTION BY: _____

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

Item	Y e s	N o	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNEL PROTECTIVE EQUIPMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				



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



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



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ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- 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



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



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

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:14-F01

REV NO.: 00

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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.		

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:14-F01

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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****HEALTH CHECK UP**

FORMAT NO: HSEP:14-F02

REV NO.: 00

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

NAME:

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

Personal History

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

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:14-F02

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

Signature of the examining doctor

**POWER SECTOR****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:

**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 fully extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:14-F09

REV NO.: 00

PAGE NO. 2 OF 03

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

WINCH

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

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:14-F09

REV NO.: 00

PAGE NO. 3 OF 03

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****INSPECTION OF HEIGHT WORKING**

FORMAT NO: HSEP:14-F10

REV NO.: 00

PAGE NO. 02 OF 02

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

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

**POWER SECTOR****INSPECTION OF WELDING AND GAS
CUTTING**

FORMAT NO: HSEP:14-F11
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	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

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

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

**POWER SECTOR****INSPECTION OF ELECTRICAL INSTALLATION**

FORMAT NO: HSEP:14-F12

REV NO.: 00

PAGE NO. 02 OF 02

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****INSPECTION OF ELEVATOR**

FORMAT NO: HSEP:14-F13

REV NO.: 00

PAGE NO. 01 OF 01

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)

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

FORMAT NO: HSEP:14-F14

REV NO.: 00

PAGE NO. 1 OF 02

Sub: MEMO for Penalty for non-compliances in Safety

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

Safety Area

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

Legend: -

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

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The 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.

1 Copy to Site Construction Manager (BHEL)

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

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

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				
NAME			NAME OF MATERIAL / EQUIPMENT / PROPERTY		
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	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: Fo1	Areas 1.	
2	Health check-up as per Format: Fo2	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. ...	
3	Induction training of newly joined workers as per Format: Fo3	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: Fo4	Locations of TBTs & No. of workers 1. ...	
5	PPE usage and issue as per Format: Fo6		
6	Inspection of T&Ps as per Format: Fo7	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: Fo8		
8	Inspection of Cranes & Winches as per Format: Fo9	List of Cranes & Winches & Nos. 1. ...	
9	Inspection of Height Working as per Format: F10	Areas: 1. ...	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. ...	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. ...	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. ...	
13	Inspection of Excavation as per Format: F13E	Locations: 1. ...	



POWER SECTOR

Format for Monthly HSE Planning & Review

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 02 OF 3

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

	POWER SECTOR		FORMAT NO: HSEP:14-F30 REV NO.: 00 PAGE NO. 03 OF 3
	Format for Monthly HSE Planning & Review		
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	
<u>Agency</u> Name:	<u>BHEL</u> Name:	<u>Agency</u> Name:	<u>BHEL</u> Name:
Sign:	Sign:	Sign:	Sign:
Date:	Date:	Date:	Date:



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

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

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

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

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

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

Night		Day	SHIFT	Year	Site
			Submitted By		
			Work Area(s)		
			Staff		
			Man-Power		
			Safety Officers		
			Safety Stewards		
			Tool Box (Topics and No. of Participants)		
			Induction Training (No. of Participants)		
			Vertigo Test (Numbers Tested)		
			On-the-Job Training (Topic & participants)		
			Work Permits		
			Job Safety Analyses conducted		
			Height Work Inspection		
			Other Hazardous Activities Inspection		
NA			T&P Inspection (Names & Nos. Inspected)		
			Safety Walk (Designation, Areas)		
NA			HSE Meeting		
NA			Safety Reward (Details)		
NA			Housekeeping/ Dust Suppression/ Tree 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		



POWER SECTOR

Job Safety Analysis Format

FORMAT NO: HSEP:14-F32B

REV NO.: 00

PAGE NO. 01 OF 1

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS				PRECAUTIONS	

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

**POWER SECTOR- HQ**

FORMAT NO: HSEP:14-F33

REV NO.: 00

PAGE NO. 01 OF 3

Checklist for Evaluation of HSE Performance

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

**POWER SECTOR- HQ**

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Checklist for Evaluation of HSE Performance

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

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

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

Note:

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



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 and in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

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

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

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

Name of BHEL Safety Representative: _____ Sign: _____

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

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

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

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

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

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

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

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**



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**

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR SITE OPERATION by SUBCONTRACTORS		Doc no.: HSEP: 14
	POWER SECTOR		REV: 01
			Date: 17.01.2020

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
17.01.2020	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/M ONREP/02 Dated 08-Jan-2020	Rohit Kumar	Santosh Nair, GM (MSX & HSE)	

