3254

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

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1.0	Project Information			
1.1	1	OWNER	:	GUJRAT STATE ELECTRICITY CORPORATION LIMITED (GSECL).
	2	PROJECT	:	**Balance Work of Electrical and Control & Instrumentation (C&I) Works for Boiler, Turbine and Its Auxiliaries for Renovation and Modernization of UKAI R&M U#3 (200MW).**
	3	PROJECT RATING	:	200 MW
	4	LOCATION	:	UKAI TPS (Thermal Power Station), Dist – Tapi, Gujarat.
	5	NEAREST RAILWAY STATION	:	Vyara- 30 Kms from project site
	7	NEAREST AIRPORT	:	Surat - 100 Kms
	8	MAIN ROAD HIGHWAYS	:	**State Highway**– accessible via State Highway 6 (SH-6).

The bidder is advised to visit and examine the site of WORKS and its surroundings and obtain for himself on his own responsibility all information that may be necessary for preparing the bid and entering into the CONTRACT. All costs for and associated with site visits shall be borne by the bidder. The information given here in under is for general guidance and shall not be contractually binding on BHEL/ Owner. All relevant site data/ information as may be necessary shall have to be obtained/ collected by the Bidder.

Title:

BALANCE WORK OF **ELECTRICAL AND C&I SYSTEM**, HANDING OVER MATERIAL TO CUSTOMER, HANDLING AT SITE STORES/STORAGE YARD, TRANSPORTATION TO SITE OF WORK, **COMPLETE ERECTION, CALIBRATION, TESTING, COMMISSIONING AND HANDING OVER OF ELECTRICAL AND CONTROL & INSTRUMENTATION WORKS** FOR BOILER AND ITS AUXILIARIES AND TURBINE AND ITS AUXILIARIES FOR **RENOVATION & MODERNIZATION OF UKAI R&M U#3 (200MW).**

Brief Scope of Work

The scope of work includes dismantling of existing a) Electrical System and b) Control & instrumentation system of Boiler, Turbine and its Auxiliaries of (UTPS Unit-3) and its transportation to Employer's workshop/stores as per employer's guidance. Transportation from place of storage to erection site, erection, testing, pre-commissioning and commissioning of Electrical System and Control & Instrumentation system and handing over in fully operable condition satisfactorily to employer.

ELECTRICAL AND CONTROL & INSTRUMENTATION (C&I) SYSTEM:

Complete dismantling, erection and commissioning of the system are in Bidder's scope.

(A) Erection:

Being R&M work, erection consists of two major parts:

1) Proper identification and dismantling of existing system wise panels, cables, LIEs/LIRs, JBs, Instruments, cable trays, etc.

2) Erection/ installation of new system wise panels, LIEs/LIRs, JBs, Instruments etc with proper glanding and termination of old field cables, laying and termination of new cables.

(1) Proper identification and dismantling:

All existing cables are armored and lifted up through panel bottom gland plate with proper glanding. Because of the weight of the cable, glanding is necessary and to be maintained in new DDCMIS panels. Proper identification of the cables with core wise usage details to be established before removal of termination/ disconnection.
After de-glanding, all cables with proper identification tags can be pulled down. Now old panels can be removed. Existing base frame with anti-vibration pads if cannot be re-used for new DDCMIS panels, to be removed.

Important Note:

Existing field cables terminated in marshalling or control panel are having different length because of allocation in various racks or location. New cables from marshalling or inter-panels are to be laid and terminated with proper glanding and identification tags/ ferrules.

(2) Erection/ Installation of new system wise panels, electrical panels, switchgear panels, control desks, HMI, marshalling panels, LIEs/LIRs, JBs, Instruments etc:

a. New power supply cables are to be laid and terminated as per requirement.

b. Existing cut-out size if necessary to be modified.

c. Civil works like modification in cut out for panels, making approach through walls, breaking of concrete floors to suite DCS Panels, Electrical Panels and Switchgear Panels erection etc. wherever required.

d. Base frames with anti-vibration pads to be erected and properly grouted after proper alignment.

e. Panel earthing where ever required to be extended.

f. New panels/ desks are to be installed.

g. Modification/ laying of trays, conduits as per system requirement.

h. Gland plate of required size and number of gland holes to be fixed/ erected.

i. Glanding, lifting, dressing, clamping and termination of identified old and new cables in new panels, marshalling panesl, supply distribution systems, power supply units and HMI including all peripherals.

(B) Commissioning:

Systems commissioning is a critical activity and hence following conditions are to be fulfilled:
Bidder has to ensure availability of expert commissioning team to successfully commission new DDCMIS system.

Commissioning of the system will comprise of activities in three parts viz. Pre-commissioning, Trial and Tuning.

1. Pre-commissioning:

i) Pre-commissioning activities starts with the powering of new panels/ HMI system.
ii) Analog and Binary field input signal loop tests and correct signal validation.
iii) Analog and Binary output signal to field and HMI tests and validation.
iv) Interfacing relay pick up through O/P modules and auxiliary contact changeover.
v) Proper window alarm through binary O/P.
vi) Proper HMI signal/ event validation.
vii) Inter-panel signal validation.
viii) HT/ LT breakers cold trial in “TEST POSITION”
ix) Motorised valves limit switches, torques switches correct status validation.
x) Solenoid operated valves, open/ close type of dampers/ valves correct status validation
xi) 220V DC, 24V DC, 110V AC, 240V AC solenoid valves trials through relays and allocated feeders.
xii) HT/ LT auxiliaries’ permissive, interlock and protection checking with breaker in test position.

2. Trials:

Trials are to be taken to ensure proper functioning of the following:

i) HT/ LT auxiliaries' actual trial with valid permit.

ii) Motorized valves actual open/ close with designed permissive and interlocks operation.

iii) Solenoid operated valves actual trials.

iv) Function testing of auto control loops in limited final control element action.

v) Boiler, Turbine, HT auxiliaries permissive, interlock and protection trials.

vi) System wise interlock and protection trials with correct alarm and event recording.

NOTE:

Trials to be hold up in case any concerned parameter is not available because of new system.

1.0.0 Following is the package wise scope of E&C work. **The scope of work is indicative type and Bidder has to carry out all the related works for completion of the project whether it is specifically mentioned or not.**

Sr. No.	ITEM DESCRIPTION	QUANTITY
1.0	Dismantling, Testing, Erection & Commissioning of Unified Distributed Digital Control Monitoring & Information System (DDCMIS) for Renovation & Modernization of complete Electrical and Control & Instrumentation system, including regulating controls, interlocks, operator interface units and requisite terminations.	
1.1	**Steam Generator Controls** comprising of Electronic System Cabinets of size (800 mm X 800 mm X 2355 mm) 1. Steam Generator Controls (SG) comprising of Electronic System Cabinets. 2. Existing power supply and field cables are to be removed after proper tagging/ Ferruling. 3. Existing panels are to be removed and replaced with newly supplied panels. 4. All civil works such as changes in cut-out size, grouting etc. are in Bidder's scope. 5. Base frames with anti-vibration pads are to be installed. 6. New panels with canopies are to be installed. Proper alignment like Levelling, verticality etc. are to be checked. 7. All existing cables are entered in the panel through proper gland of panel bottom gland plate. 8. Existing Field control element and primary sensors shall be retained except newly offered system. 9. Existing field cables shall be retained with suitable marshalling panels and gland plates. However, new field/main cables may need to be laid and terminated with proper glands, tags and ferrules as per requirement. 10. Minimum emergency backup console to be installed. Necessary wirings with DDCMIS panels to be done. 11. Power supplies to be distributed from existing UPS, G1/ G2 board, 110V ACCSP panels and new UPS if supplied. 12. 110V AC both sources are available and are to be connected to newly supplied static switch panel and commissioned.	1set Approx. 03 Panels

	13. Static switch panel output through newly supplied distribution board to be connected to FSSS panels. (optional) 14. Existing Safe Flame Scanners to be replaced by New flame scanner system for all coal elevations and oil elevations with necessary mechanical modifications and field cabling. 15. Existing power supplies are to be used where ever possible. Additional supplies if required are to be hooked up from existing UPS, G1/ G2 boards etc. by Bidder. If new UPS is supplied/provided, then necessary incomer feeder installation and commissioning, cabling work along with accessories shall be in the Bidder's scope. 16. All civil works such as removal of existing grouted base frame, changes in cut-out size of floor etc. are to be in the scope of Bidder.	

1.2	**Steam Turbine Controls** comprising of Electronic System Cabinets of size (800 mm X 800 mm X 2355 mm) 1. Electro Hydraulic Governor 2. Introduction of Axial shift 2/3 electrical Trip/ Electrical over speed Trip/ Variable condenser Vacuum set point protection/ Low M.S. temperature protection. 3. Provision of Vacuum Pump Control in proposed DDCMIS to replace existing local control panel with solenoids and necessary cabling. 4. New contactless power switches for switching of power signals to existing motorising control valves of Lub oil temperature control, Primary water temperature control, Cold gas temperature control, HP C/F temperature control. However, existing motorising control valves shall be retained and used as it is. 5. Main Turbine Existing Electro-Hydraulic Governor (EHG) along with feedback transmitter is to be replaced with I/H converter or proportional valve with amplifier and capacitor module and 02 no. of LVDT/Micro pulse type position feedback transmitter along with necessary mechanical accessories. 6. LP Bypass existing plunger coil type EHG and its feedback unit is to be replaced with proportional-directional control valve and minimum 01 feedback unit. All necessary modifications like piping, mounting & any mechanical work to upgrade the system will be in agency's scope. (optional) 7. Installation and commissioning of Turbovisory System for main turbine along with Analysis and Diagnostic software package. 8. Installation and commissioning of new type of speed probes for main turbine speed measurement with necessary mechanical arrangement as per requirement. 9. Existing Field control element and primary sensors like orifice, flow nozzles etc. shall be retained. 10. Existing field cables shall be retained with suitable marshalling panels. However, new field/main cables may need to be laid and terminated with proper glands, tags and ferrules as per requirement. 11. Installation and commissioning of new Auto Synchronizer and LSR is in Bidder's scope.	1set Approx 22 panels

12. Existing panels are to be removed after proper cable tagging and MTP disconnection. New panels are to be accommodated in the available space.
13. HP/ IP control valves, LPBP control valves LVDT type PFTs are now connected to 7MJ modules. Same LVDTs are to be interfaced with DDCMIS modules. (optional)
14. Vibration probes are to be installed in X-Y direction with necessary cabling where vertical provision on bearing housings is available.
15. MOT/FRF/Hotwell Level tank level measurement of guided wave radar type of level transmitters are to be installed and commissioned with required cabling up to DDCMIS.
16. FCNRVs PFTs are to be replaced and hooked up to DDCMIS. (optional)
17. Local panel analog indicator for seal oil pressure, hydrogen pressure, seal oil/ Hydrogen DP, Hydrogen purity and current of all general auxiliaries to be retained.
18. All cabling to and from DCDB chargers and distribution board to individual panels is in the scope of Bidder.
19. AVR, GCB, Field breaker and control interface to be covered in DDCMIS along with hard wired back-ups on control desk as per existing scheme.
20. Existing pressure, level, differential pressure, flow transmitters of critical parameters are to be replaced with necessary mechanical piping changes.
21. Existing RTD and Thermocouples temperature transmitters are to be replaced with proper field mounting.
22. Installation and commissioning of newly supplied transmitters along with manifolds and required accessories shall be in Bidder's scope
23. Commissioning of new GAMP (Generator Auxiliary Monitoring Panel) system in place of existing panel with complete electrical and switchgear accessories, cables and interfacing of the same to DDCMIS. (optional)
24. Limit Switches are used for open and close feedback of ESVs of HPT and IPT. These are to be replaced with 2-wire proximity sensors.
25. Control Valves position is measured using resistive type rotary pot which are to be replaced with LVDT sensors or any other suitable linear technology.

Sr. No.	ITEM DESCRIPTION	QUANTITY
1.3	**Station C&I:** Electronic System Cabinets of size (800 mm X 800 mm X 2355 mm) Catering to 1. Hooking-up of approx. 300 no. Temperature signals pertaining to HT auxiliaries with proposed DDCMIS system. 2. Existing Control Desk shall be removed and existing PB and indicators of the same or new PB and indicators shall be provided and shall be placed under extended new HMI desk. Also paralleling of the same shall be done with the proposed DDCMIS system. Existing Field control element and primary sensors like orifice, flow nozzles etc. shall be retained. 3. Existing field cables shall be retained with suitable modifications of existing marshalling cabinets or supply of new cabinets. However, new field/main cables may need to be laid and terminated with proper glands, tags and ferrules as per requirement. 4. Minimum emergency backup console shall be provided. 5. Existing power supply shall be retained for powering of panels. However, new power cables may need to be laid, terminated with proper glands, tags etc. as per requirement. 6. 220V DC contact rating relays to be supplied in relay panel mounted on bases and wired up to TB. 7. Existing pressure, level, differential pressure, flow transmitters of critical parameters are to be replaced with necessary mechanical piping changes. 8. Existing RTD and Thermocouples temperature transmitters are to be replaced with proper field mounting. 9. Complete E&C of Field Instruments including JB's for marshalling existing field cables with new cabinets etc. 10. Hooking up of Temp. Signals (Approximately 300 Nos.) directly coming from Field to Temp. Scanners on existing UCP pertaining to HT auxiliaries (Existing Field cables to be retained). 11. Installation and commissioning of newly supplied transmitters along with manifolds and required accessories shall be in Bidder's scope.	01 Set

2.0	**Electrical System:** **Erection and Commissioning of following systems are included** 1. Electrical Actuators. 2. DC motor starter box. 3. Electrical Hoist 4. Fire Sealing System 5. Numerical Relays Commissioning 6. 220V DC Battery Charging System 7. 11kV/ 3.3kV/ 0.415kV Switchgear/ PCC/ MCC 8. AC/ DC Starter panel/ Local starter boxes/ Power distribution boxes/ Marshalling boxes. 9. Control & Relay Panels. 10. Above Ground Earthing and Lightning Protection systems. 11. 11/ 3.3kV Segregated Phase Bus Duct (SPBD). 12. Soot Blower System. 13. Only Testing & Commissioning of certain items as mentioned in the BOQ erected by other agencies (Electrical Hoists, HVR Transformers, DG sets, etc.) 14. Other Misc. associated equipment	

<u>CIVIL WORK:</u>

All civil work involved in up-gradation of Electrical and C&I system is in the scope of Bidder.

Scope of civil works involves:

- Fabrication of base frames for panels/ cabinets is in Bidder's scope along with supply of fabrication material as per BOQ. Bidder must provide material test certificate along with supply material as per BOQ.
- The Bidder shall hand over the dismantled material or the dispose of the already removed material at the Customer's designated place. This will also include disconnection/replacement of the existing cabling/ piping as applicable.
- The required civil works for floor cut-outs for additional panel are to be made by the bidder. This may need use of specialized tools and techniques to cut through the concrete. The material and T&P's required for this will be in bidder's scope.
- The required civil works for floor cut-outs for additional panels to be located in existing free space in existing relay room/Control room, compressor room.
- Extension of earthing system as per requirement.
- Laying and termination of power cables.
- Laying and termination of additional cables as per scope.
- Underground routing, Laying and termination of optical fiber cable as per requirement.
- Erection of HMI system with peripherals.
- Erection and Commissioning of the instruments is under the scope of Bidder.
- Any other civil work arising because of system up-gradation is in Bidder's scope.
- **All materials (Cement, concrete, Iron/TMT bars etc.) related to civil work including T&P and manpower shall be in the scope of bidder.**

MECHANICAL WORKS:

All the mechanical work involved in up-gradation of Electrical and C&I system is in the scope of Bidder.

Scope of mechanical works involves:

1. Cutting/ welding of instruments impulse pipes

a. Hot well level control radar type transmitters.

b. MOT/ FRF Guided wave radar type level transmitters.

c. Control panels, Control desks etc.

d. Flame scanner guide pipe assemblies.

e. Any other works as per requirement.

2. Main turbine key-phasor/ notch preparation for diagnostic system.

3. **Main Turbine's any mechanical work required for the new Turbovisory system (TSS/TSI). This involves drilling/tapping of holes, minor modifications in the brackets etc required for mounting of TSI sensors.**

4. Any other mechanical work arising because of system up-gradation is in Bidder's scope.

NOTE:

Whatever things required for complete Electrical and C&I up-gradation of Unit shall be in the scope of work, irrespectively whether it is specifically mentioned in the enquiry specification/ scope of work or not.

2.0.0 GENERAL REQUIREMENTS

2.1.1

The intent of specification is to procure services according to the most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for proper and efficient execution of this work shall not relieve the contractor of the responsibility of providing such facilities to complete the work without any extra compensation.

2.1.2

The work covered under this specification is of highly sophisticated nature, requiring the best quality of workmanship, engineering and construction management. The contractor should ensure proper planning and successful & timely completion of the work to meet the overall project schedule. The contractor must deploy adequate quantity of tools & plants, measuring instruments, calibrating equipment, modern/ latest construction aids etc. He must also deploy adequately trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor should match requirement of sophistication involved with the items mentioned in the BOQ.

2.1.3

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

2.1.4

Contractor shall erect, align and commission all the equipment and auxiliaries as per the sequence & methodology prescribed by BHEL depending upon the technical requirements. Availability of materials and fronts will decide this. BHEL Engineer's decision regarding correctness of the work and method of working shall be final and binding on the contractor. No claims for extra payment from the contractor will be entertained on the ground of deviation from the methods/ sequences adopted in erection of similar sets elsewhere.

2.1.5

The services, tests and support to be provided by the agency for the work mentioned in the various sections of this tender are indicative and not exhaustive, but not limited to these for the completion of the work in all respects.

2.1.6

The work to be carried out under the scope of this specification covers the complete work of loading, handling, transporting, unloading, preassembly, dismantling, erection, calibration, testing, air flushing, pre-commissioning tests, commissioning of systems, trial run of various auxiliaries, achieving various activities till handing over of the unit to BHEL's customer, providing maintenance team to cater to guarantee responsibilities and maintenance thereafter. The work shall conform to dimensions and tolerances specified in various drawings that will be provided during the erection. **If any portion of the work is found to be defective in workmanship or not conforming to drawings or other specifications, the contractor shall dismantle and re-do the work duly replacing the defective materials at his cost, failing which the work will be got done departmentally or by engaging other agencies and recoveries will be affected from contractor's bills towards expenditure incurred including 30% departmental charges.**

2.1.7

Contractor shall dismantle, calibrate, erect, commission all the equipment, cabinets/panels, instruments and cabling etc. as per sequence prescribed by BHEL at site. The sequence of dismantling/ erection / commissioning methodology will be decided by the BHEL engineers depending upon the availability of materials/work fronts etc. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of dismantling/ erection / commissioning adopted in erection / commissioning of similar jobs or for any reasons whatsoever.

2.1.8

The services, tests and support to be provided by the agency for the work mentioned in the various sections of this tender are indicative and not exhaustive, but not limited to these for the completion of the work in all respects.

2.1.9

Plant materials should not be used for any temporary supports/ scaffolding/ preparing pre-assembly bed etc.

2.1.10

The contractor shall have total responsibility for all equipment and materials in his custody at contractor's stores, or any loose, semi-assembled, assembled or erected by him at site. He shall effectively protect the finished works from action of weather and from damages or defacement and shall also cover the finished parts immediately on completion of work as per BHEL Engineer's instructions. The machined surfaces/ finished surfaces should be greased and covered.

2.1.11

At all stages of work, equipment/ materials in the custody of contractor, including those erected, will have to be preserved as per the instructions of BHEL. The contractor shall make all fixtures, temporary supports, steel structures required for jigs & fixtures, anchors for load and guide pulleys

required for the work (excepting, those specifically included in BHEL scope). However, necessary steel will be provided from the scrap/ surplus materials available at site.

2.1.12

The terminal points decided by BHEL shall be final and binding on the contractor for deciding the scope of work and effecting payment for the work done.

2.1.13

Descriptions of certain packages appearing in the rate schedule are available in this section to give general idea to tenderer about the type of equipment to be erected, calibrated, tested and commissioned.

2.1.14

During the course of dismantling, erection, testing and commissioning of C&I work, certain rework/ modification/ rectification/ repairs/ fabrication etc., will be necessary on account of feedback from various thermal power stations or units already commissioned and/or units under erection and commissioning and also on account of design discrepancies and manufacturing defects and site operation/ maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication repairs etc. promptly and expeditiously. Daily log sheets indicating the details of work carried out, man-hours, consumables used etc., shall be maintained by the contractor and got signed by BHEL engineer every day. Claims of contractor, if any, for such works will be dealt as per clauses 2.15 of GCC

2.1.15

The contractor's scope of work is further described in the clauses hereafter:

2.1.16

All tools, tackles, fixtures, equipment, materials, manpower, supervisors/ engineers, consumables, electrodes including oxygen, acetylene argon etc gases, primers, paints etc. required for this scope of work shall be provided by the contractor. All expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clause. The contractor’s quoted rates should be inclusive of all such contingencies. Electrodes shall be baked / dried in the electrode drying oven (range 375 – 425 deg C) to the temperature and period specified by BHEL Engineer before their use. Necessary drying oven / portable oven shall be provided by the contractor at his cost.

2.1.17

The scope of work under this tender specification covers transportation (to & fro and before erection & after dismantling), calibration, dismantling, erection, testing and commissioning, etc. of control / instrumentation and electrical equipment of the following packages.

A. Boiler Control & Instrumentation and its Auxiliaries

Digital Distributed microprocessor based max DNA system panels for FSSS, SADC, HP Bypass,

auxiliary PRDS, Soot blowers, Electronic water level indicator, Blanks Cabinets for flame scanner system etc.

B. Steam Turbine and TDBFP Control & Instrumentation and its auxiliaries

Digital distributed microprocessor based maxDNA system panels consist of Turbine Stress Evaluator, Electro Hydraulic Governor (EHG), LPBP Seal/ Gland Steam control, Turbovisory System (TSS/ TSI) for Main Turbine, turbine extended protection, Turbine & generator auto control loops, Turbine protection Channel, TDBFP controls along with interlocks, protection and TSS, GAMP (Generator Auxiliary Monitoring Panel), Main turbine existing moving coil type Electro-Hydraulic Governor (EHG), etc.

C. Station C&I / Balance of Plant

Digital Distributed microprocessor based maxDNA system panels for Balance of Plant controls, consisting of Open Loop and Closed Loop controls, interlock and protection systems for various HT, LT, pneumatic, hydraulic drives, remote multiplexed signal acquisition, alarm processing, HMI including computers and accessories, computer furniture, control desk, Large Video Screen, instrumentation, cabling, etc, etc.

2.1.18

Equipment /instruments required to be erected for this work, though not limited to but are generally as per rate schedule. For any items or class of work not specified herein but required for total completion of work, the same shall be carried out as per BHEL requirement. However, the payment of these items/class of work shall be regulated as per the General Condition of the contract. Contractor shall provide necessary resources for completion of such work within the stipulated time schedule. Value of such work shall be included while computing the total value of work finally executed for all contractual purposes, particularly for contract variation purpose.

2.1.19 Electronic Earth Pit

Erection of separate electronic earth pit for new system will be in scope of bidder including material.

A separate instrumentation earth pit shall be provided for the I&C system (control system/ equipment/ instruments) by bidder which shall be isolated from the plant earth.

Electronics earthing resistance shall be < 0.5 ohm.

2.2 BRIEF DESCRIPTION OF WORK

2.2.1 Collection of materials

2.2.1.1

The contractor shall take delivery of equipment, materials from the storage yard/ stores/sheds of BHEL/Customer. He shall also plan for verification of equipment, safe custody, watch and ward of equipment after it has been handed over to bidder till these are fully erected, tested and

commissioned and taken over by the customer. The contractor should note that the transport of equipment to erection site, assembly yards, etc. should be done by the prescribed route in the most professional manner without disturbing other on- going works of various contractors. Special equipment (whichever applicable) such as laboratory equipment, measuring and control equipment, gauges, panels, console inserts, switches, transmitters, controllers, power cylinders, cables, conduits etc. shall be stored when taken over by the contractor in appropriate manner as per BHEL's instructions. The contractor should also note that while taking delivery of materials from BHEL stores (open/closed), it may be necessary to handle other items which could be blocking the exit route of the materials.

2.2.1.2

The contractor shall take delivery of the components, equipment and special consumables from the storage area/sheds of BHEL/customer after getting the approval of the engineer/customer on standard indent forms to be specified by BHEL/customer.

2.2.1.3

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

2.2.2

All works such as cleaning, levelling, aligning, trial assembly, dismantling of certain equipment/components for checking and cleaning, fabrication of tubes and pipes as per general engineering practice and as per BHEL engineer's instructions at site, cutting, weld depositing, grinding, straightening, chamfering, filing of cut outs/openings for mounting of console inserts, modules, indicators, recorders, drilling of holes for gland entries, reaming, scrapping, cable laying, dressing, fitting up etc. as may be applicable in such erection works are treated as incidentals to erection work and are necessary to complete the work satisfactorily shall be carried out by the contractor as part of the work.

2.2.3

Overhauling, cleaning, revisioning, servicing of equipment / instruments, valves etc. during erection and commissioning stages will be arranged by the contractor. However, gaskets /packing for replacement will be provided by BHEL free of cost. All equipment shall be preserved and protected before and after erection as per the advice of BHEL engineer.

2.2.4

The contractor should take all reasonable care to protect equipment and materials under his custody either in his stores or at site. Copper tubing, brass fittings, brass valves etc. forming an integral part of equipment or system are liable to greater damages / pilferages /theft / losses. It will be

responsibility of contractor to arrange for adequate security round the clock for protection from such damages / pilferages / theft / losses.

2.2.5

All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the engineer. The equipment from the storage yard shall be moved to the actual site of erection/location at the appropriate time as per the direction of BHEL engineer to avoid damage/loss of such equipment at site.

2.2.6

House Keeping & Scrap Disposal: The contractor shall collect all scrap materials (scrap related to Panels, cables, trays, insulation, wooden, civil debris etc.) periodically from various levels of power house, working area of the power station, auxiliary and piping around power station and collect the same at one place earmarked for the same. Loads of scraps are 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.

The dismantled material shall also be transported from site to the place designated by the Customer. ***This aspect shall be taken care of in the quoted rates and no extra payment shall be done in this regard*****. It shall be the contractor's responsibility to arrange necessary cranes/tractors, trailer, trucks, slings, labor, etc., etc., for transport of equipment to and from site to designated location as decided by BHEL/ Customer.**

2.2.7

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.

2.2.8

All pipes and tubes, equipment, instruments issued to contractor and kept at site for erection shall be covered with plastic caps/steel caps or shall be closed with suitable plugs by the contractor.

2.2.9

The contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storage are removed before these equipment's are erected in position.

2.2.10

Contractor shall plan and transport equipment/components from storage yard/sheds to erection site and erect them in such a manner and in a sequence that material accumulation at site should not lead to congestion. Materials shall be stacked neatly, preserved and stored in the contractor's shed and work areas in an orderly manner. It may be specifically noted that the space available in the thermal power plant is limited and accumulation of material may lead to the necessity of shifting and restacking the materials to enable other agencies to carry on with their work or to comply with customer's requirements. If required, the contractor shall arrange shifting

of surplus material expeditiously failing which the same will be arranged by BHEL and all charges together with departmental charges at 30% will be recovered from his bills.

2.2.11

House-keeping in the erection and pre-assembly area is as important as the well-planned and orderly work. The access to site for inspection approaches by BHEL and customer engineers and leading of the material shall be made available by the contractor at all times. The shifting and re-shifting of erection materials, tools and plants and clearance of restrictions, filling of ditches, undulation near the preassembly and boiler area is the responsibility of the contractor. Contractor should visit the site and acquaint himself with all restrictions and difficulties that he may encounter during erection/commissioning stages.

2.2.12

The work under this scope being quite sophisticated and also quite extensive, for proper planning, monitoring, reporting, etc of ongoing works, the contractor shall establish his own computer(s) and printer(s) at his site office, along with suitable operator(s), consumables, etc. *Non-establishment of above equipment will attract penalty @ Rs 10000 (Rupees Ten thousand only) per month.*

BHEL uses its own software SOMS (Site Operation and Management System) for total project execution and billing. The contractor shall also provide adequate and suitable manpower for updating / entries into SOMS in BHEL computers at site.

2.2.13 <u>Troubleshooting during plant operation</u>

During pre-commissioning / commissioning stages when the plant will be under various stages of operation, it will be necessary to have continuous (day and night) 24 Hrs presence of suitable manpower along with required tools to attend to any defects etc that may arise during such operation. The contractor will be required to put such personnel in shifts in C&I and Electrical area. The bidder must also take this aspect into consideration.

As the Shutdown Activities (from complete steam generation stoppage up to first Synchronization of Unit) has to be completed within prescribed period, the contractor has to ensure round the clock (24X7) availability of manpower and deploy required number of manpower/personnel in shifts during the complete shutdown period.

2.2.14 Pre-commissioning / commissioning and post commissioning activities.

2.2.14.1

The work is also inclusive of various commissioning activities of BHEL scope. The various 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.

2.2.14.2

In case any malfunctioning and/or defects are found during tests, trial runs such as loose components, undue noise or vibration, strain on connected equipment etc., the contractor shall immediately attend to these defects/ malfunctions and take necessary corrective measures. If any readjustment and realignment is necessary, the same shall be done as per BHEL engineer's instructions.

2.2.14.3

During each stage of commissioning, if any part of the instrument needs repair/rectification/rework/replacement, the same shall be done expeditiously and promptly by the contractor. Contractor's claim, if any, for such repair/rectification/ rework/replacement etc. for reasons not attributable to contractor will be dealt as per clauses 2.15 of GCC. The parts to be replaced shall however be provided by BHEL free of cost.

2.2.14.4

Simultaneous commissioning activities will be in progress in various areas. All these works need specialized gangs including electricians/instrument mechanics in each area. Contractor shall earmark separate manpower for various commissioning activities. This manpower shall not be disturbed or diverted.

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

2.2.14.5 Contractor shall cut open works if needed as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over without any extra payment.

2.2.14.6

In case any rework / repair / rectification / modification / fabrication etc. is required because of contractor's faulty erection which is noticed during commissioning or at any stage, the same has to be rectified by the contractor at his cost. If any improvement /repair /rework/rectification/ fabrication/ modification due to design improvement/ requirement is involved, the same shall be carried out by the contractor promptly and expeditiously. Claims of contractor, if any, for such works will be dealt as per clauses 2.15 of GCC

2.2.14.7

It is the responsibility of contractor to provide for necessary labor, tools and tackles and consumables till the completion of work under these specifications even in case dismantling, erection, testing and commissioning of this work is delayed due to reasons not attributable to the contractor.

2.2.14.8

During commissioning activities and carrying out various tests, minor items like gauges, manometers, etc., have to be temporarily erected and put in service to suit the commissioning activities. BHEL will provide the necessary gauges and equipment. Contractor has to carry out the erection, calibration, dismantling of the same. After completion of activities the temporary systems have to be removed and returned to stores. No extra charges will be payable towards these.

2.2.14.9 Commissioning

During pre-commissioning, commissioning, post commissioning and trial operation stages of various systems, certain category of manpower with T&P and consumables will have to be provided to BHEL commissioning engineers exclusively at their disposal. It shall be the responsibility of the contractor to provide Engineers, Electricians, technicians, Helpers, Fitters etc along with necessary consumables, hand tools, calibration equipment etc, for the various commissioning activities in progress. During shutdown period there could be requirements of separate commissioning gangs simultaneously in even up to 12 to 15 areas. Contractor has to augment the manpower as and when required as per work demand and necessity at site. The quoted rates shall include this.

2.2.14.10

It shall be specifically noted that contractor manpower may have to be engaged round the clock simultaneously at different areas and hence considerable number of personnel and their overtime payment may be involved. *This aspect must be considered by the contractor while quoting their rate.* No additional compensation by for the same shall be payable, irrespective of number of persons engaged or number of working hours per day.

2.2.14.11

For electrical works, 415 volts and above, the contractor has to bring qualified electricians.

2.2.14.12

Certain systems may be supplied with portable programming units, which are to be connected at various locations during pre-commissioning to handing over. Necessary cabling interconnecting the programming units and other connected panels has to be carried out by the contractor and are to be dismantled after work. For the purpose of testing, monitoring, commissioning, etc., these programming units will have to be repeatedly connected and disconnected at various locations. These will be considered as part of commissioning activities and no separate payment will be entertained for the above.

2.2.14.13 Calibration, Testing & Commissioning

Calibration, testing & commissioning activity as specified in this technical specification and rate schedule against various equipment, devices, systems etc. are broadly classified below. However, there may be some overlapping between the activities (dismantling, erection, calibration and testing, commissioning). The classification of activity is only a guideline for understanding the total

volume of work in each activity. The contractor shall have no claim for performing or providing manpower for such overlapping work, which is also within the scope of the work.

(A) Calibration

Verification after drawing of material of various types, range of the field devices with respect to instrument schedule, data sheet or system document.

- Codification of instruments as per system tag numbers
- **Calibration / adjustment of instrument as per system requirement / set values.**
- Providing head correction in case of pressure measurement as per calculated values or actual measured value for the instrument, which are used for interlock protections / monitoring. This is generally applicable for turbine / generator, lube oil systems, lube oil system of fans etc.
- Verification of installation of instruments for range, type, tag number as per physical location of process point as per process, instrumentation diagram.
- Checking and ensuring the proper function of instrument.
- All the recorders shall be made functional with proper chart movement and ink marking (if applicable).
- Preparation of computerized calibration certificates in the formats specified by BHEL Engineers and getting those signed by the customer is in the scope of the contractor.

(B) Erection

- Withdrawal of material from store, verification, inspection as per shipping list, drawings and documents.
- Preservation, up keeping, safe custody of the erected equipment till handing over to the customer.
- Verification of installation as per drawing and document for the correctness of cabling, JBs, impulse pipe, various field device, panels, instruments etc.
- Continuity check and IR value check of cables.
- Verification of correction of cable termination with respect to instrument, electrical hook-up diagram, panel interconnection diagram, JB schedule.
- Checking earthing of the equipment and cable shield wire continuity.
- Energizing the functional group control panels and field devices.
- Flushing of impulse pipe before making the instruments process connections through.
- Any leakages, damages to impulse pipe, field device connections, air connections etc. shall be fully attended by contractor.
- All cable glands/piping/tubing to be fixed as per installation requirement before commissioning.

(C) Testing, Commissioning & Trial Operation

- Checking/verification of binary/analogue input and output signal from field and panel and up to recording/indicating instrument/HMI monitors.

- Checking the operating electrical/pneumatic drive through functional group panel, remote control desk, HMI, CRT operation and repeatability and smooth operation to be checked.

- Checking the interlock, protection and alarm for various process by simulation of field devices/process changes.

- Functional check of sub-loop control, sub group control and auto loop and fine tuning.

- Adjustment of limit switches/feedback position transmitter checking the actuator for correct Limit switch operation for correct position indication and repeatability shall be ensured.

- Motor IR value measurement, bearing/winding RTD checking, drying out of motor, providing assistance for trial run of motor which includes monitoring temperature rise winding/bearing during trial run.

- **Contractor shall prepare calibration/testing report/protocols.**

- During trial run of various systems, if the performance of any instrument is found erratic, un-satisfactory and requires re-adjustment, re-calibration etc., the defect shall be attended by contractor.

- Observing and checking the performance of the various devices on load/process variation. Any deficiencies/defect noticed during the variable load conditions, the same should be attended properly.

- Observe the proper functioning of sub-group/sub-loop control.

- Check the operation of various controls in manual/auto mode for smooth functioning.

- Clearing of all bad / invalid signals noticed during commissioning.

- Providing necessary assistance during restart of the unit is in scope of this specification. Smooth operation and availability of all instrument/controls of the systems installed under the scope herein, shall be ensured by the contractor. Contractor shall provide adequate number of skilled manpower and T&P for this purpose. Interruption during restart till stable operations at full load or any mutually agreeable load for reasons attributable to the Contractor may result in re-start of the unit all over again, consequential extension in Time Schedule / Contract Period shall be to the contractor's account.

- If any small wiring correction or minor modification in control panel wiring is noticed during the commissioning, it shall be carried out as a part of commissioning activity.

(D) Post-commissioning

- Contractor shall rectify the defect observed/informed by customer during the restart of the Unit

- Contractor shall submit the as- built drawing as per guidelines and instruction of BHEL engineer.

- After restart/handing over of the equipment, if due to unforeseen reasons, certain works crop up, the contractor shall provide all the assistance.

(E) Tests & PG Test Assistance (Kindly refer Annexure-C)

2.3 CABLE TRAYS/ CABLE DUCTS WITH SUPPORTS AND ACCESSORIES

2.3.1

Various types of sheet metal, galvanized cable tray, i.e. Perforated, ladder type, seal metal duct, solid bottom tray, shall be provided in standard lengths along with accessories like hardware, bends, reducers, coupler plate, tray covers and tray clamps etc. Tightening/ fastening of tray clamp shall be under contractor's scope.

2.3.2

Installation of cable tray/cable duct shall include cutting, laying, jointing, supporting, drilling holes in the support, providing tees/reducers/bends/clamps as per tray route layout, fabrication of bends/tees/reducers from straight length, fixing of tray covers, welding of tray on support, cleaning and application of cold galvanizing paint on weld joints (supply of paint is in the scope of contractor). *Installation of tray/duct covers, wherever provided, will be done as a part of tray erection and no extra rates will be payable.*

2.3.3

Fabrication of bends/ tee/ reducers from straight length of tray is within the scope of work and rate quoted shall be inclusive in unit rate (in running meters). All site welds of cable trays shall be painted with approved primer and cold galvanizing paint, which shall be arranged by the contractor.

2.3.4

Before start of work support structure/ cable tray work in cable vault, the existing cables of fire alarm system, power and control cables are to be protected to avoid the damage from fire, cutting welds and etc.

2.3.5

In case cable trays are required to be fabricated from structural steel and installed, unit rate applicable for fabrication and installation of structural steel shall be applicable in such instance.

2.3.6

Cable trays/ducts etc. may have to be routed underground in cable trench, over head on structure, valves, floors etc. for various applications such as cable laying, copper tubes, conduits, thermocouple, temperature gauge capillary etc.

2.3.7

Cutting and rerouting shall be carried out within the quoted rates for completion of work.

2.3.8

The cable trays shall be supported in general at a span of 1.5m horizontally and at a distance of 1m vertically. All sharp edges and burr shall be removed. Cable tray on the top tier shall have cover whenever running below pipes.

2.4 CABLE LAYING

(POWER/ CONTROL/ INSTRUMENTATION: SHIELDED/ UNSHIELDED/ PLUG-IN/ COAXIAL/ UTP/ STP/ DATA HIGHWAY, ARMOURED/ UN-ARMOURED, SINGLE/ MULTI-CORE, PVC/ HR PVC/ FRLS/ TEFLON/ PTFE/ XLPE INSULATION, OPTICAL FIBER, ETC.)

2.4.1

Cable laying includes cutting to the required length, laying in overhead/underground cable trench/through pipes/flexible conduits, dressing/clamping in tray, drilling of holes in gland plates in panels and junction box, glanding, splicing, dressing of spliced wire inside the panel and JBs, providing PVC numerical/alphabetical / printed ferrules, termination by using crimp type copper tinned/aluminum lugs, insulated/un-insulated, termination (crimp, soldering, etc.), plug-in connections with insert type crimping, providing identification PVC/aluminum cable tags (at both the ends and at 15 m intervals throughout the route length and also at each bend), continuity checking, insulation resistance checking, high voltage test on HT cables.

Laying, etc of Optical fibre cables on cable trays /cable trench shall necessarily be done using flexible conduit

2.4.2

The cable tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, cable may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags.

For buried cable, the marker shall project at least 150mm above ground and shall be spaced at an internal of 20m and at every change of direction.

2.4.3

All the cables shall be clamped to the cable trays/ support structure with the help of clamps. Cables to be strapped to tray at interval not greater than 300mm. All power cables shall be clamped individually and control cables shall be clamped in groups of 3 or 4 cables. Clamps for multicore cables shall be fabricated out of 25x3mm aluminium flats. Single core power cables shall be laid in trefoil formation and suitably clamped with Al cast/ Glass Fiber Clamp. All sharp edges and burr shall be removed. Erection Agency shall carry out the plant cabling works in line with customer/ consultant's Technical Specification.

Cables to be strapped to tray at interval not greater than 300mm.

2.4.4

Damaged cable drums also to be used within the quoted rates. No extra compensation for difficulty in cable laying due to damaged drums shall be made.

2.4.5

Entry to the panels and JBs may be at top, sides or bottom. All cables are required to be properly supported and clamped near to the JB/panel.

2.4.6

Spare holes in the panels/ Instruments/ Actuators/ Motors/ JBs/ etc. shall be sealed by the contractor using suitable method (The cost of work and Materials such as aluminium sheet or Adhesive tape/ Plugs etc. shall be within the quoted rates for laying of cables).

2.4.7

Wherever cable glanding is not possible, either due to the gland plate size limitations or more number of cable entries, prefab plug-in cables, etc., for such cases cables may have to be lifted inside the panel by either making cut-out in gland plate and providing rubber profile for sharp edge protection or alternatively, providing 4" or 6" PVC pipe coupling gland and these pipe coupling gland shall be supplied by contractor within the quoted rate of cable laying.

2.4.8

Copper tinned lugs of various types (pin, ring, fork, snap-on) upto 4 sq.mm, PVC cable ties, PVC ferrules, PVC button and tapes, cable identification tag of PVC/metallic, clamping and dressing material with hardware, PVC sleeves etc. shall be supplied by the contractor within the quoted rates for cable laying. The quality of material shall be got approved from BHEL engineer prior to their use on job.

2.4.9

All care should be taken to avoid abrasion, tension, twisting, kinking, and stretching of cables during installation.

2.4.10

Cable shielding – all signal cables are supplied with bare shielded copper wire/with braided wire shield. Generally, shield wire is kept isolated at instrument/field device end and continuity is maintained through JBs and grounded at panel end only. While terminating the shield wire either in panel or JBs, PVC sleeves are to be used to avoid two-point earthing.

2.4.11

Wherever cables run through ducts, conduits, valves, etc., they shall be sealed using fire/weather proof compound. In addition to this, cable entry in panels, MCCs, instruments, electrical actuators etc., are also required to be sealed. The required material for doing so shall be included by contractor in the cabling scope.

2.4.12

Many of the cable trays and cables have to be laid in cable trenches. For this purpose, the cover of the trenches have to be opened for working in site and whenever the cables are to be laid in existing cable tray, all safety precautions have to be observed.

After completing the work, the trenches have to be cleaned and covers put back into position. Contractor shall also carry out de-watering from the trenches if required and arrange pumps etc., at his cost.

2.4.13

Looping wire at terminal block of panels and electrical actuator as shown in the inter-connection diagrams or as required is to be done by contractor at no extra cost.

2.4.14

Contractor shall carefully plan the cutting schedule of each cable drum in consultation with site engineer such that wastages are minimized. In any case, the wastage shall not exceed the limits mentioned in this contract. Recovery will be made in case the wastages are exceeding the wastage allowances fixed in this contract.

2.4.15

The erection contractor shall make every effort to minimize wastage during erection work. In any case, **the wastage shall not exceed the following limits;**

Sl. No.	Item	% Wastage on issued Qty
1.	Fabrication steel	2
2.	Each size of power cables	1
3.	Each size of control/Instrument cables	2
4.	Impulse pipe/tubes/GI pipes/copper tube	1

If however, the bidder quotes for more wastage than specified above, the excess portion will be considered for adjustment during the tender evaluation at the quoted supply rate of material.

If the actual wastage be more than the specified figure, then equivalent price of the excess portion will be deducted from the contractor's bill.

2.4.16

In case of HT cable, cutting schedule is to be followed as provided by BHEL.

2.4.17

The HT/ LT Power and control cabling work shall be carried out in advance so that same can be terminated at panel end as the clearance is ready from the panel E&C side.

2.4.18

The termination and connection of cables shall be carried out strictly in accordance with manufacturer's instruction, drawings, and/ or as directed by the BHEL. The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting, and grounding as required for the complete job. Cables shall be checked for insulation resistance before and after jointing. All erection consumables shall be in Erection Agency's scope. Termination and connection shall be carried out in such a manner as to avoid strain on the terminals. Cables shall be marked with cable numbers as per applicable drawing.

2.4.19

Control cable cores entering control panel/ switchgear/ MCC etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

2.4.20

All cable entry points shall be properly sealed and made vermin proof and dustproof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least 03 hours.

2.4.21

The rate of laying for LT power, control and signal cable is inclusive of glanding and termination at both ends.

2.4.22

The LT Power, Control and Signal Cable straight through Jointing Kits (if required) shall be in Contractor's scope of supply. The rate of supply, and erection of these kits will be part of laying rates. No separate rate is applicable on this account.

2.4.23

Ferrules shall be installed on all control cables cores in all junction boxes and at all terminations. The ferruling shall be cross ferruling. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be colored, plastic & interlocked type. Spare cores shall also be similarly ferrules, crimped with lug and aped on the ends. Spare cores shall be ferruled with individual cable number, crimped with lug and aped on the ends.

2.4.24 Terminal Connections:

The types of cable terminations are generally as detailed below:

1) All field cables in SG package are crimp type of different sizes.
2) All JBs are both side screw type.
3) All console tiles wiring: screwed or plug-in type to be fabricated at site.

2.4.25

Existing/old cables are to be disconnected from old Panels and re-connected to the new Panels. If the existing cables are short in length, same has to be joined by straight lugs of various types (pin, ring, fork, snap-on) upto 4 sq.mm and reconnected to the new DCS Panels.

2.4.26

For removal of existing Cables, Cable Induction meter of applicable Voltage is mandatory to confirm that the cable is charged or not.

2.4.27

Unit rate quoted for cable lying shall include the activities as defined above.

2.5 Junction Boxes/Push Buttons:

Different types of junction boxes are to be erected by the contractor like junction boxes below 48 ways and above 48 ways. The junction boxes are to be located at the locations jointly decided at site during erection. The junction boxes are to be erected on the frames fabricated at site. Brief work will include:

a. Checking of installation for correctness.
b. Functional checking/ adjustment of JB/ PB for their system.
c. Hardware for erection (Like Nuts, Bolts and Washers etc.) where ever is required shall be in the scope of the contractor.

2.6 LAYING OF PIPES AND TUBES (IMPULSE PIPE & INSTRUMENT AIR PIPE)

2.6.1

Root valves are generally provided on process pipe line by other agencies. Prior to starting impulse pipe, contractor to identify the process point with respect to PIDs.

2.6.2

Installation of impulse pipe of CS/AS/SS material shall include cleaning, air flushing, cutting to length from running meter, edge preparation, cold bending, welding of sockets / reducers / tee / cross / isolating valves / union, nut and tail pieces / nipples, condensing and other pots, etc., mounting of SS/CS valve manifolds and compression fittings, providing supports, clamping, conducting leak test / hydraulic pressure test, painting as per colour code (primer and two coats) and erection and commissioning of other standard accessories as per instrument hook-up diagram.

Piping works shall involve either arc or TIG welding. Paint, primer etc supply is in the scope of the contractor. Colour codes for impulse piping, etc will be as per standard codes. Contractor to follow the BHEL supplied welding schedule and welding procedures. The decision of BHEL engineer will be final in this regard.

2.6.3

IBR certified welders shall be deployed for welding of impulse pipe and contractor shall take approval for welder and welding consumables from BHEL site engineer.

2.6.4

Laying of GI pipe for instrument airline shall include air blowing, cutting from the running meter length, threading, installation of elbows/tee/reducer /moisture traps/auto drain pot/check valves/isolating valves, supporting clamping, conducting leak test and also seal welding of threaded joints, if required.

2.6.5

Threaded joints of airline shall be made leak proof by using Teflon tapes or sealing compound. All consumables shall be in the scope of contractor.

2.6.6

All fittings and accessories for impulse pipe and airline shall be provided by BHEL. Quoted rate for piping shall include cost of installation of such fittings and no separate rates are envisaged.

2.6.7

Contractor shall provide GI "U" clamps for impulse pipe and GI pipes within the quoted rates for installation of the same.

2.6.8

Impulse pipes (as per paint schedule) shall be applied with one coat of primer red oxide paint and two coats of synthetic enamel of prescribed shade of final paint. BHEL may prescribe a time gap between first coat and second coat of final paint.

2.6.9

Installation of Copper tubes/ SS tubes/ copper pipes shall include cutting into required length, laying, bending, cleaning, brazing wherever required, fixing of brass fittings like compression fittings/ tees/ end connectors/ straight connectors/ bulk heads/ valves etc., supporting clamping including supply of clamps and hardware, flushing and conducting leak test.

2.7 STRUCTURAL STEEL FABRICATION AND INSTALLATION (Instrument/ Junction Box Frame/ Panel Base Frame/ Cable Tray & Misc. Structures Fabrication)

2.7.1

Structural steel material like MS angles, channels, beams, flats, plates etc. shall be supplied in running meter and the same shall be used for misc. fabrication if required and for fabrication of Local Instrument Racks, panel base frame, cable tray supports, Canopies for instruments/ panels/ drives/ JBs/ Push Buttons etc., Instrument/ Junction box frames, Impulse Pipe/ Instrument Air Pipe supports and instruments etc.

2.7.2

This shall include cutting into size, conduiting of end connections, if required, welding, grinding of excess weld deposits, drilling of holes for mounting of device/instrument, installation at location, levelling, alignment, providing bracings, painting etc. No gas cut holes will be permitted. Contractor to follow the BHEL supplied welding schedule and welding procedures.

2.7.3

Frame installation/cable tray accessories' installation at site may involve mounting either on concrete floor by grouting/using anchor fasteners or on steel structure by welding etc. *All consumables including anchor fasteners shall be arranged by the contractor***.** Where required, as part of work, concrete floors may have to be chipped out to reinforcement depth for anchoring the frames. Wherever grouting is required, contractor shall arrange all the required material including cement/ grout mix, shuttering etc., necessary labour and meet all other requirements as part of work.

2.7.4

In certain packages, galvanised members of junction box frames and instrument racks shall be supplied in cut to sizes and frame assemblies are required to be done as per drawing by bolting/welding. The installation rate as quoted shall include the assembling of the frames.

2.7.5

Gas cutting of tray/impulse pipe support and gas cut holes in frame shall be avoided. Only drilled hole shall be permitted in frame etc.

2.7.6

All the fabricated supports/frames shall be applied with one coat of primer red oxide paint before installation and two coat of synthetic enamel of prescribed shade of final paint,. If required, BHEL shall prescribe time gap between first and second coat of final paint. Supply of paint, primer etc. are in contractor's scope.

2.7.7

Hardware for erection (Like Nuts, Bolts and Washers, etc.) where ever is required shall be in the scope of the contractor.

2.8 INSTALLATION OF PANELS (POWER DISTRIBUTION BOX/ MARSHALLING BOX/ CONTROL PANELS/DCS PANELS)

2.8.1

Electrical control panels, electronic control panels, 415-volt LT MCCs, DCS Panels etc., are normally supplied in suite of either one/ two/ three or loose shipping sections with integral base frame or loose base frame. These panels may have to be installed as stand-alone or in-group consisting of number of panels in each row, depending upon the plant layout and foundation arrangement.

2.8.2

The panels shall be transported from stores to the place of installation in vertical position. Care shall be taken such that the switches, lamps, instruments etc. mounted on the panel do not get damaged during transit.

2.8.3

Installation of panel shall include **construction/ fabrication of base frame**, levelling, alignment, fixing of anti-vibration pads, removal of side covers, fixing of cubicle interconnection hardware, bus bar jointing, wiring interconnection, welding and grouting of panels and base frames, mounting of panel canopy wherever supplied as part of panel, drilling of gland plates and sealing of cable entries. Where the base frame or canopyis not supplied as part of panel supply, the contractor shall fabricate the same from structural items at site. Payment for such fabrication will be affected on measured quantity at the rate applicable for structural steel fabrication and installation. Proper sealing of all the holes and cable entries (even if the cable has been laid by others) in the panel is in the contractor's scope

2.8.4

Panels have to be shifted to their locations through floor openings, temporary openings like floor grills, door etc. which shall be part of work and no claim whatsoever will be entertained with regard to non-availability of opening as per shortest route etc. Panel have to be erected at different locations and elevation in boiler, TG, GTG hall, LT & HT switchgear room, unit control room, ESP control room etc.

2.8.5

Panel and instruments once erected in position should be properly protected using necessary care to prevent ingress of dust/moisture. This will have to be periodically cleaned and surroundings have to be kept tidy. Necessary canopies for Instruments and JBs shall be provided.

2.8.6

Wherever the panels to be mounted on cable trenches, channel supports have to be provided across the cable trench over which the base frame of panel shall be mounted. For such work, structural steel fabrication, installation rates shall be applicable.

2.8.7

Normally the panels shall be supplied with instruments, relays, meters, electronic modules etc. mounted and pre-wired. However, if these are supplied loose / separately for safety in transit, contractor shall mount/wire such devices as part of the panel installation work and no separate rates shall be applicable unless otherwise *specially* listed in the rate schedule.

2.8.8

No separate payment shall be made for replacement of any devices like electronic modules, relays, conductors, terminal block, push buttons etc. which are found defective during pre-commissioning / post-commissioning of any equipment / item.

2.8.9

For the panels erected by other agencies, commissioning/calibration work and troubleshooting has to be carried out by the contractor as part of testing and commissioning work as per the quoted rates.

Interposing Relays (24/ 48 Volt DC) along with mounting base if supplied shall be supplied separately for mounting in the various feeders of 11kV/ 3.3kV HT switchgear boards and 415 Volt MCC Board for unidirectional/ bi-directional drives, solenoid valves.

2.8.10

Associated civil works like drilling, chipping, punching holes and opening in concrete floors, slabs and brick walls, grouting, related to Rack, support fabrication and installation, associated civil works required for installation of control panels, Junction boxes etc., shall be included in the erection cost of such items. Also all associated civil works like chipping away and making good as necessary in floor slab/wall for cabling / earthing etc., as required are included in the scope for which no separate payment is applicable. The scope also includes supply of grouting material, if any. Mechanical works as per BOQ is also in the scope of the contractor.

2.8.11

Supplier's instruction manuals, packing slips, door keys etc. received along with the panels should be promptly handed over to BHEL's engineer on opening of the panels.

2.9 Control panels

SG, TG, Station C&I system panels are based on maxDNA/ metso DNA distributed digital control philosophy. MaxDNA/ Metso DNA system is having communication through UTP cables amongst themselves. The system consists of computer network with servers and workstations and various peripherals like printers, etc. Optical fiber cables are also used for communication, especially for

larger distances. The various components/ devices are generally located in control room/ computer room/ diagnostic and shift in charge room. Some panels (viz. network panels) are also located in outdoor plants and other units.

The entire work of erection, testing, commissioning of the connected devices/ equipment as listed in rate schedule is to be carried out including laying of peripherals cables (either plug-in or plugs to be fabricated at site), placement of computer furniture in computer room as per lay out. The computer furniture shall be supplied either assembled or in knocked down condition, which have to be assembled at site. The quoted rate shall be inclusive of transportation, cable laying, termination, E&C and placement of furniture (Computer tables, Computer Chairs & Printer table) against each device as given in the rate schedule.

2.10 BATTERY/ BATTERY CHARGER

2.10.1

Ni-Cd/Lead Acid (or similar type) Batteries will be supplied loose along with battery interconnection in the series/ parallel links/ bus bar, lugs, steel/ wooden battery stand either assembled or knocked down condition, cables and associated charger and UPS system.

2.10.2

In case of Ni-Cd (or similar type) batteries are normally supplied in charged condition, due care shall be exercised while handling/ installation of the same. If the battery charge is found to be less than the required level, the charging/ discharging cycle shall be carried out as per instruction of BHEL engineer.

2.10.3

Battery charging/ discharging is a continuous process and skilled manpower shall be deployed by the contractor round-the-clock.

2.10.4

Contractor shall arrange suitable load, cables, safety equipment and consumables for discharging the battery during charging and discharging cycle at his cost.

2.10.5

Contractor shall provide skilled manpower for periodic maintenance after the battery are fully charged for the activities such as checking of electrolyte level, specific gravity, topping up with distilled water and cleaning till the set is handed over to customer and record of the same shall be maintained and submitted before handing over of the system.

2.11 FIELD INSTRUMENTATION

2.11.1

Various type of primary/secondary indicating/recording instrument for pressure, temperature, flow, level and analytical measurement shall be supplied either loose or mounted along with the equipment.

2.11.2

Scope of work under **erection/calibration/testing/commissioning** shall include calibration, setting, adjustment, writing instrument tag number with paint, report making, installation, servicing, minor repairs/servicing, putting instrument into service, signal checking from field up to the functional group panels and remote indicating instrument, functional checks, interlock and protection/alarm checks by simulating the field devices, troubleshooting during pre-commissioning/post-commissioning till system is handed over to the customer.

2.11.3

It is the responsibility of contractor to make erection, calibration/testing protocols for various C&I equipment/devices and they should get duly certified by customer/BHEL engineer and should be submitted to BHEL engineer regularly. However, sample formats will be given by BHEL and have to be printed by contractor in adequate numbers.

2.11.4

Contractor shall establish calibration laboratory with adequate facilities and they should arrange standard test instruments duly calibrated from recognized agencies and calibration report of the same to be submitted prior to start of calibration of the field instruments/devices.

2.11.5

Wherever thermowells are supplied along with temperature gauges, thermocouples, temperature switches, thermostats, etc., the bidder has to fix the thermowells on the pipeline. However, actual fixing of thermowells on pipeline and seal welding shall be done by the bidder.

2.11.6

Installation of instrument shall also include drilling of holes and tapping for mounting of instrument and local instrument frames/panels and supply of hardware for mounting of the instrument.

2.11.7

Some devices line solenoid valves, position feedback transmitters, limit switches, air filter regulators, airlock relays, positioners etc., are supplied assembled along with mechanical equipments like pneumatic control valves, power cylinders, trip valves, dampers, motorised actuators, etc. These will need removal, calibration/testing, re-fixing, adjustment, etc., and commissioning. Separate payment shall not be made for this. The rates quoted for the commissioning of these equipments (viz., pneumatic control valves, power cylinders, trip valves, dampers, etc.) should take care of the above. Also, the contractor shall remove such devices prior to erection either at site or at store to avoid damages/pilferages and keeping in safe custody and the same shall be installed prior to commissioning of such equipment.

2.11.8

Transmitter enclosure/ open racks (LIE/ LIR) for various packages which are to be erected and commissioned at various locations of the turbine and outdoors, shall be supplied with internal tubing, air filter regulators, rotameters, provision of continuous or intermittent purging

arrangements wherever required, etc. The quoted rates for these racks/ enclosures shall include the erection and commissioning of all such items inside these racks/ enclosures.

2.11.9

Sometimes recalibration of equipments may become necessary due to reasons not attributable to the contractor, e.g. Lapse of Time after first calibration, Need for change in range/parameter, etc. If re-calibration is required due to no fault of the contractor, the rates payable for re-calibration shall be as under:

Recalibration Charges = 60% of the Percentage Stage Payment for Calibration as per split-up defined in Terms of Payment

The contractor shall keep record of such instrument with the reason for re-calibration and certified by the BHEL Engineer.

Note: For recalibration of skid mounted items or other systems where lump-sum rates are quoted, the recalibration charges, if admissible, will be calculated from the relevant unit rates quoted for same / similar items elsewhere in the rate schedule. The decision of BHEL Engineer shall be final and binding on the contractor.

2.11.10

For the very few cases where required, the contractor shall carry out re-orientation of bottom/top entry arrangement for process connection if needed due to site condition in existing instrument rack/enclosure/JB and re-location of existing instrument including removing of the existing tubing and re-installation of the same at appropriate location due to any change in grouping of the instrument and no extra payment shall be applicable.

2.11.11

In certain cases, instruments / devices are supplied on equipment or drawn by other agencies as part of mechanical package. The same are to be received or to be collected from other agencies for keeping in safe custody to avoid damages. The same are to be erected back after calibration for which unit rate shall be applicable for erection and calibration. Contractor shall maintain record of such instrument duly certified by BHEL engineer. However for removal of such instrument, no separate rate/payment shall be applicable.

2.12 Unit control desk and components

2.12.1 Unit control desk will be supplied in a single shipping section for erection at site.

Console Inserts shall be supplied either mounted on console grid or supplied loose. Also, the items (indicators, pushbuttons, etc.) of the console insert may be supplied mounted in the console insert or may be supplied loose. The lump-sum rates quoted for console inserts should take the above into consideration. No separate payment will be done for the erection of individual components of console inserts. However, for the other items like recorders, indicators, etc., unit rate shall be applicable. Alarm facia on the control desk may be supplied mounted or loose. Mounting these, if

required, will not attract any extra payments. The commissioning of these will constitute a part of the panel commissioning from where the alarm is driven.

2.12.2

Wherever control desk / panel is not supplied by BHEL or is in customer scope of supply and installation, loose item supplied by BHEL if any, shall have to be mounted by the contractor.

2.12.3

Console/console tiles shall have plug-in/screwed/soldering/crimp snap-on, connection. Interconnecting cable between console and process control panel shall be either of pre-fabricated plug-in cable or plugs are required to be made at site with crimp insertion type of pins. BHEL shall provide plugs and any special lugs at free of cost. However, other ordinary lugs required for the work shall be arranged by contractor.

2.12.4

Generally, 0.5 sq.mm multi pair shielded cables are envisaged for console cabling. Cable may have to be terminated at different console tiles, spliced wire of individual cable need to be routed through PVC sleeves up-to the plug end of the tiles.

2.13 MISC. OTHER INSTRUMENT/ EQUIPMENT ERECTION, CALIBRATION AND COMMISSIONING.

2.13.1

Wherever panels, pneumatic power cylinders and control valves have been erected by the contractor, calibration/ commissioning has to be carried out by the contractor.

2.13.2

Dimension and weight as mentioned against control panels, MCCs, etc. in rate schedule are only approximate and there may be changes in dimension and weight in actual supply of the equipment and no rate variation shall be applicable on this account.

2.13.3

Wherever brief description of the system is given under various sub-heads, it is only for the understanding system requirements. It does not indicate the total specification of work. For such system, other clauses are also applicable wherein work details are specified.

2.13.4

Normally, cable glands on junction boxes side are received in mounted condition. While terminating the cables as per drawings, the cable glands are to be removed and fixed. Wherever cable glands are not received along with junction boxes, the cable glands as per the requirement will be provided by BHEL and the contractor has to make necessary holes/adjust the available holes in the JB for fixing these. No separate payment will be made for drilling of holes and fixing the cable glands to the junction boxes. Nameplates for JBs will be supplied separately. These are to be suitably written and fixed onto the JBs. Wherever nameplates for JBs are not supplied, the JB no. are to be written with paint on JBs for identification. Separate payment will not be made for this.

2.13.5

The push buttons and indicators in C&I systems are provided as loose with different type of connectors. The fixing of connectors and their wiring from push buttons to indicators shall be the responsibility of contractor. No separate payment will be made for fixing of connectors. The cable laying and termination charges will be paid as per applicable rate schedule.

2.13.6

If applicable-The calibration of position transmitters of the NRVs in the turbine extraction system has to be carried out by the contractor. Position transmitters are to be erected by contractor if supplied loose.

2.13.7

If applicable-The solenoids in the corner valves / HEA will be received in mounted condition and will be erected by the mechanical contractor. The contractor has to provide the services required for dismantling the solenoids and reinstalling the same after servicing/adjustment. Payments will be made as per testing/commissioning portion of the rate quoted for these items and no extra charges will be payable for removal and re-fixing. Small items like speed regulators, etc. will have to be fitted in the copper tubing route of corner stations. No separate rate will be applicable for such devices.

2.13.7

SADC power cylinders are to be erected by contractor in coordination with other agencies as per instructions of BHEL. For SADC power cylinders, copper tubing and accessories will be supplied by BHEL. The copper tubing work from the instrument line header to the power cylinder and the internal connection to be carried out by the contractor as per site requirement. Necessary security against pilferage is to be arranged by contractor.

2.14 GUIDELINES FOR ERECTION

2.14.1 Impulse Pipelines

a. All impulse lines, air lines shall be thoroughly cleaned by removing the dust, burrs etc., and any foreign matter inside the pipe/ airline is to be cleaned by compressed air or any other suitable means before installation.
b. The routing of pipe lines shall include sufficient flexibility near tap off points to allow for thermal expansion of process equipment.
c. The pipes shall be cold bent using hydraulic bending machines only.
d. The horizontal impulse lines shall be laid with proper slopes towards the tapping point. Two root valves are to be used wherever pressure is more than 40 kg/cm2 or Temp>280 °C .
e. Supports for piping and tubing shall be adequate and in no case exceed limits shown below: -

1	1/4" OD / 3/8" OD copper	Continuous
2	1/2" NB pipe/ tube	5 ft.
3	3/4" NB pipe/ tube	5 ft.
4	1" NB pipe/tube	8 ft.

f. All CS impulse line welding shall be done through welding generator/ rectifier and only structural welding may be done with welding transformer.

g. Impulse pipes of alloy steel/ SS/ carbon steel etc. shall be TIG welded. Contractor shall arrange for necessary TIG welding sets, electrodes etc.

h. Minimum number of fittings shall be used on all lines wherever possible, to keep threaded joints to a minimum wherever threaded connections are to be made.

i. Testing
On completion of pipeline installation, the pipelines shall be hydraulically tested. Contractor shall arrange for water filling pump, hydraulic test pump and standard gauges and conduct the test satisfactorily.

j. The impulse lines shall be isolated from instruments and tested at 2 times the maximum working pressure. The fall in pressure shall not be more than 1 kg/cm2 or 1% of the working pressures whichever is less, in 30 minutes and there shall be no leaks at any of joints/ welds when isolated from source of pressure.

k. All weld joint in CS, SS, AS (High Pressure) line are subject to 100% radiography test with minimum two shots per joint.

2.14.2 Air Piping

All instrument air pipelines shall be isolated from the instruments and pressurized pneumatically to maximum work pressure. They shall then be isolated from the source of pressure and fall shall be less than 1 psi in 20 minutes.

2.14.2 Pneumatic Signal Lines

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 leaks and attended accordingly.

2.14.3 Instruments and Equipment

a. All field mounted instruments are to be located in such a way as not to obstruct walk-ways or plant equipment access but shall be easily accessible for maintenance. Hand rails shall not be used for mounting or supporting instruments.

b. Racks/ stands and supports for instruments and transmitters shall be fixed on RCC column/ floor by chipping and grouting or by welding to steel structure. In no case these shall be welded to floor grills.

c. When installing flow and pressure transmitters/ switches for Liquid/ steam/ condensate vapour services, the instrument is to be mounted below its primary element or tapping point. For gas service applications, the instrument is to be mounted above Primary element tapping point.
d. During erection and commissioning stage, the site mounted instrument shall be protected suitably. Contractor shall provide suitable security arrangement in main control room, and other areas where equipment are positioned, at no extra cost.
e. Contractor shall arrange for own firefighting equipment for the materials stored under contractor's custody.
f. The power cylinders support/base erection will be welded to steel structure or by grouting. The power cylinder will be properly aligned and linkage mechanism wherever required shall be connected to the driven equipment. All accessories for power cylinders line air sets, solenoid valves, air lock, limit switches, if supplied loose, shall be fixed, aligned and connected up.

2.14.4 Sub-assemblies

a. All subassemblies should be kept in a separate place where it is easily accessible.
b. Subassemblies 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. Subassemblies should not be stacked one above the other.

2.14.5 Loose-Items

The loose items supplied for the main equipment falls into various categories like tools, cables, prefabricated cables, console inserts, recorders, VDU/CRT, other display units, printers, sensors and transducers, cable glands, cable ducts, frames, racks, etc. These are to be categorized and stored separately.

2.14.6 Guidelines for handling of electronic modules

a. All the electronic modules shall be handled by qualified persons only.
b. Electronic modules should only be touched when it is absolutely essential to do so.
c. Before touching any electronic module, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strap.
d. The operator should not wear clothing made entirely from synthetic fibres, but a mixture containing at least 65% cotton.
e. The PCB should always be held by front panel or by module frame and electronic components/ connectors should never be touched.
f. The electronic modules should not 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.

2.14.7 Welding, Non-destructive testing etc.

a. Installation of equipment involves good quality welding, NDE checks etc.

b. Welder deployed for aluminium welding shall have experienced and approved by BHEL and BHEL's Customer after due qualification process/ testing.
c. Welding of all structural steel & aluminium shall be done only by the qualified and approved welders.
d. All the welders shall be tested and approved by BHEL engineer/ Customer's quality engineer before they are actually engaged on work though they may possess IBR/ other certificate. BHEL reserves the right to reject any welder without assigning any reason.
e. The welded surface shall be cleaned of slag and painted with primer paint to prevent corrosion. For this paint will be supplied by the contractor.
f. Welding electrodes have to be stored in enclosures having temperature and humidity control arrangement. This enclosure shall meet BHEL specifications.
g. Certain types of coated welding electrodes, prior to their use, call for baking for specified period and will have to be held at specified temperature for specified period. Also, during execution, the coated welding electrodes have to be carried in portable ovens

2.15 ELECTRICAL CABLING, EARTHING AND ABOVE GROUND EARTHING

2.15.1 ELECTRICAL CABLING/ WIRING

a. All the cables will be properly laid in cable trays, dressed and clamped with aluminium flats. The cable will be terminated at both ends with suitable lugs and printed ferrules and will be glanded properly. Suitable equipment and consumables for ferrule printing has to be arranged by the contractor at his own cost. For cable identification, the contractor shall provide at his cost aluminium tags at regular intervals (as per cable schedule) through each run of cable.
b. All electrical connections shall be tested for polarity and proper connections.
c. Insulation test of the various circuits shall be done.
d. The checking of operation of individual equipment and instruments to which the cabling/ wiring connected shall also be done by the contractor.
e. Wherever supplied, GI cable trays shall be of bolted construction only with fixing screws and coupler plates.
f. Sharp bends of cable trays shall be avoided in all type of cable trays.
g. Installation of cable racks and supports structure shall be carried out in all the required areas. Steel embedment shall be provided in the cable trenches, ceiling slabs and concrete blocks for installing the cable racks and support structures.
h. Ladder perforated type cable trays shall be used in cable trenches and vertical risers.
i. Perforated cable trays shall be used in higher elevations in Boiler and Generator area.
j. Cable racks in the trenches and control room are to be shared with other contractors installing cables in different areas wherever required. Contractor shall cooperate with the other contractors in sharing the cable trays and proper dressing and clamping the cables.
k. Where power and control cables are to be laid in the same route, suitable barriers to segregate them physically shall be employed.
l. Space equal to the diameter of cable shall be provided between power cables of six over 50 mm in diameter.
m. When cables pass through floors, walls etc., it shall be passed through a pipe for mechanical protection and the pipe ends sealed suitably.

n. Care shall be taken to avoid short bending and kinking of conductor damaging insulation and stressing the cable beyond pulling force recommended by the manufacturer. Cable shall be protected at all times from mechanical damage.
o. The minimum radius of formed bend of an insulated cable shall be 12d for un-armoured cables and 15d for armoured cables where 'd' is the overall diameter of the cables.
p. No cable shall be laid in ducts or trenches where other services such as oil pipes, steam or water pipes are laid.
q. Where cabling passes through brickwork or concrete work, the contractor shall provide suitable local protection against mechanical damage wherever necessary.
r. The layout of all cables shall be arranged to give adequate clearance from other services and cables shall be routed to avoid hot zones. No extra cost shall be considered for rework.
s. Jointing of cables shall be avoided as far as practicable. However, jointing if at all necessary shall be done by crimping type cable joints after getting approval of BHEL engineer.
t. The cable schedules indicating cable sizes, tentative cables routing information will be furnished by BHEL at site to the contractor. Required steel inserts on cable trenches, will be provided by BHEL. The contractor shall design number of cable/ racks to accommodate the cables on racks/ trays properly.
u. Detailed specification shall be as per instruction of site engineer.

2.15.2 EARTHING INSTALLATIONS

a. All equipment shall be earthed by two separate and distinct connections. Earthing terminals will be available in all equipment supplied by BHEL.
b. The earthing conductors shall be of mild steel/ GI strip/ wires. All connections from equipment to main earthing conductors shall be made as illustrated in earthing drawing/ as per instruction of BHEL engineer. Suitable "Cu" Lugs are to be supplied for earthing with GI wire by the agency where ever is required.
c. A continuous earthing conductor shall be installed in all cable 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 in parallel, a continuous earthing conductor shall be provided on trays only with tap offs to the control cable trays. All valve and damper motors and rapping motors will be earthed to this conductor.
d. All joints in the earthing system shall be welded type. Earthing connections to all equipment including motors shall be bolted type.
e. Earthing connections shall be free from tinning scale paint, enamel, grease, rust or dirt at the time of making joint.
f. Metallic sheaths, screens/ shields and armour of all multicore cables shall be bonded and earthed.
g. Earthing conductors along their run on columns, beams, walls etc. shall be supported by suitable cleats at intervals as specified by BHEL site engineer.
h. Welded joints on GI earthing conductors shall be painted as mentioned in the Typical Arrangement drawing. For site welded GI strips/wires which are exposed these are required to be painted with one coat of cold galvanising zinc paint. Contractor to arrange the required paints and other items at his cost.

2.15.3 ABOVE GROUND EARTHING

a. The contractor shall carry out above ground earthing for all Electrical equipment, which may be erected by him, or some other agency. Different type of earthing materials shall be supplied and the contractor shall lay and connect the earthing materials as per site requirement and as detailed in drawings. Unit rate for earthing material shall be paid on running meter basis.
b. All equipment shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.
c. Parts of all electrical equipment and machinery not intended to be live shall have two separate and distinct earth connections each to conform to the stipulation of the Indian Electricity Rules and apparatus rated 240V and below may have single earth connections.
d. Generally, risers are provided near the structure/ equipment foundation, in case risers are not visible and buried below the foundation level, contractor shall carry out necessary earth excavation for connecting the above ground earthing strips. Wherever welding is involved necessary protective coating shall be applied on weld joints.
e. 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 bidder.
f. 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.
g. 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 200mm spare length left for further connections to equipment earthing terminals.
h. Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations/ IS code of practice IS 3043-1947 and further amendments thereof and Indian Electricity Rules, so that the values of the step and contact potentials in case of faults are kept within safe permissible limits.
i. If any outer shops and buildings as well as the electrical sub-stations and electrical rooms are also in contractor's scope, a ring main earthing system will be provided. Ring main earthing systems shall again be interconnected as a network to power plant main earthing mat. Internal earthing ring in the electrical equipment room shall be provided by the contractor irrespective of whether equipment of the area is in their scope or not.
j. For different floors in a building, localized internal earthing ring shall be formed and connected to the ground earthing through vertical risers. The earthing mat shall be common to both power and lighting installations.
k. A minimum of two spare earth rings will be provided in each floor of the building for earthing future building.
l. Each RCC steel column of the building will be interconnected to the floor-earthing grid in basement/ ground floor.
m. For protective earthing separate conductor shall be used for flow of earth fault current.
n. Contractor shall carry out minor civil i.e. chipping of floor (where earth strip is to be laid on floor), removal of topsoil for laying earth strip in switchyard area, etc.
o. It is the responsibility of contractor to provide skilled manpower for periodic maintenance after the initial commissioning till handing over the system to customer. During this period the activities are to be carried out such as checking the electrolyte & specific gravity of individual battery, topping up of electrolyte, cleaning etc.

2.16 GUIDELINES FOR HANDLING AND STORAGE OF ELECTRONIC CUBICLES/SUB-ASSEMBLIES/LOOSE ITEMS.

2.16.1 Handling

a. Immediately after unloading at site, the electronic equipment should be kept in a covered area. Handling and lifting of package should be done without jerks or impacts. Packing case should not be dropped or slid along the floor under any circumstances. Suitable forklift should be used to move the case to its final position. All above points are to be strictly followed as electronic equipment may get damaged due to vibration and shock.

b. After unloading at site, the package of the equipment shall be inspected for external damage. In case the package is damaged, package number and details of damage should be noted. The details of damage should be reported to concerned site engineer.

c. Cases should be opened/unpacked using correct nail pullers. While opening the planks, care should be taken to see that equipment inside 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.

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

e. Hinged frames should not be opened when equipment is not secured to 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 bottom wooden pallet.

2.16.2 Storage

a. The equipment should be preferably in its original package and should not be unpacked until it is absolutely necessary for its installation or advised by BHEL engineer. The equipment should be best protected in its cases. It should be arranged away from walls.

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

c. Periodic inspection if silica gel placed inside the equipment is necessary. It has to be replaced or regenerated when decolourisation takes place.

d. 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.

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

f. All the equipment, 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 engineer.

g. The packing material shall be retained if the cubicle is to be repacked after inspection.

2.17 33/6.6kV HT SWITCHGEAR, 415 VOLT LT SWITCHGEAR

GENERAL

a. Mechanical functional checking/ adjustment of individual breaker.
b. Measurement of Insulation resistance of individual breaker, complete switchgear board and combined insulation resistance of individual breaker with cable connected to drives.
c. Testing of Relays, Power transducers, Energy Meters, Ammeters, Voltmeters, Power factor, frequency, tri-vector meters & metering, etc. in static & dynamic condition relay.
d. Checking of electrical control & protection interlock of individual breaker and integration with other system.
e. Calibration of energy meters, tri-vector meters, voltmeters, ammeters, power current & voltage transducers, etc.
f. Provide assistance for checking the electrical operation of individual breakers from remote panels/ MMI package (maxDNA system).

2.18 ELECTRICAL ACTUATORS

The scope of Testing and Commissioning of electrically operated actuators for valves, dampers, gates, soot blowers etc., will include meggering, providing loop wire on actuator terminal block, adjustments of mechanical/ electrical or electronic position transmitters, setting of limit/ torque switches, cable checking, internal wiring checking, local/ remote operation from MCC & MMI package (maxDNA system), replacement of limit/ torque switches if required.

2.19 LIE's AND LIR's

Local instrument enclosures are closed type housing for field instruments. These have to be located in suitable places, impulse piping and cabling to be done. Number of instruments in each LIE will vary.

The various LIEs are:

- LIE TYPE A: 2200 (H) mm x 1450(W) mm x 1000(D) mm
- LIE TYPE B: 2200 (H) mm x 1100(W) mm x 1000(D) mm
- LIE TYPE C: 2200 (H) mm x 800(W) mm x 1000(D) mm

Local instrument racks are open type housing for field instruments. These have to be located in suitable places, impulse piping and cabling to be done. Number of instruments in each LIR will vary.

The various LIRs are:

- LIR TYPE A: 2200(H) mm x 200+1400+150(W) mm x 650(D) mm
- LIR TYPE B: 2200(H) mm x 200+1100+150(W) mm x 650(D) mm
- LIR TYPE C: 1600(H) mm x 200+800+150(W) mm x 650(D) mm

2.20 HEA EXCITER SYSTEM

H.E.A. Exciter box along with retractor assembly, flexible spark rod, spark tip, flexible HT cable assembly, S.S. Hose (1 Mtr long, 6.35 mm ID), Air Filter Regulator, limit switches etc.

2.21 SOOT BLOWER SYSTEM

Soot blower system comprises of motor control centre / Local Starter Boxes having various feeders of motor starters / Switch Fuse Units, micro-processor-based PLC panel with mimic diagram and control station, push button boxes, junction boxes, wall blowers/LRSB with drive mechanism, integral control box with limit switch and internal wiring, inter connecting cables between field blowers and MCC, PLC panel etc. The scope of work for testing, commissioning covers the items/devices as per rate schedule and the testing, commissioning of blowers shall be carried out in close co-ordination with mechanical agencies who shall be erecting these blowers and contractor shall obtain clearance from BHEL engineer prior to start of work. The contractor shall carry out the following works under testing & commissioning: -

- Pre-commissioning checks and tests on MCC's / Local Starter Boxes, soot blowers, PLC panels, energisation of MCC and its feeders, wiring checks, insulation resistance measurements, testing of thermal over load relays etc.
- Adjustment of limit switches, torque switches, internal wiring checks, minor wiring modification to suit to system requirements for wall/LRSB blowers.
- Electric operation of each blower from local, MCC / Local Starter Box and PLC panels and from Unit control board.
- Providing loop on terminal block of MCC individual feeders & blowers.

During pre-commissioning / post-commissioning of soot blower system, the component like TB's, limit switch, torque switch, over load relay, contactors etc. if found defective, contractor shall replace such components without any extra payment.

2.22 FLUE GAS ANALYZERS

- **OXYGEN ANALYZER**

The system consists of Zirconia probes, electronic units Panel for mounting electronic unit, purging and calibration gas arrangements, etc. The probes are meant for direct mounting on duct / chimney, etc., at suitable elevation.

- **CO ANALYZER**

CO Gas Analyser consisting of:

CO Sensor head mounted on probe with CO2, H20 measurement, In-situ High Temp. probe (SS316L) 1.8m insertion length (8''Flange),347 deg C, Temperature transmitter with cable mounted on probe,

Pressure transmitter with cable mounted on probe, Pneumatic panel consist of accessories (Digital Display Unit with 10 m cable, Air Dryer Unit, Power Supply unit, 230 VAC I/P, 24 VDC O/P)

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2.24 Final painting

2.24.1 All the fabricated frames, instrument racks, Junction box frame, trays / impulse pipes, supports, panel base frame, etc., wherever applicable shall be first painted with one coat of primer paint (metal red oxide) and then two coats of synthetic enamel paint of approved shade (decided by BHEL Engineer) after thoroughly cleaning the surface of dust, rust, scale, grease, oil, etc., by wire brushing, scrapping or any other suitable method. The quoted rates should be inclusive of all these **including supply of paints and consumables.**

2.24.2

Other equipment like JBs, Panels, transmitter racks, Local gauge boards etc., shall be painted with two coats of synthetic enamel paint. The quoted rates should be inclusive of application of two final coats of synthetic enamel paint. All the consumables such as wire brush, other cleaning materials, painting implements, etc., is to be arranged by the contractor at his own cost. All equipment painting will be done by spray painting. The quoted rates should be inclusive of all these including supply of paints and consumables.

2.24.3

Cable trays shall, in general, be connected by bolted joints. However, in some cases welding of joints may be required. All the weld joints of GI cable trays and GI structural members shall be applied with a coat of cold galvanising zinc paint. Paint, etc. shall be arranged by contractor at his cost.

The contractor shall provide the Primer (ROZC as per IS:2074) for the scope of painting work indicated in Section-4 as well as for protection of site weld joints and gas cut locations. Contractor shall also arrange to provide the required thinner and other consumables, T&P etc. **required for application of ROZC Primer. All paints and thinners shall be sourced only from BHEL approved manufacturers. Some of them are as listed under:**

- M/ s Asian Paints
- M/ s Berger paints
- M/ s Jenson & Nicholson
- M/ s Shalimar Paints
- M/ s Akzo Nobel
- M/ s Kansai Nerolac Paints

In order to have consistency in painting system, it is preferable that all the supplies are sourced from one single manufacturer.

Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6" peripheral area, adjoining to damaged area to be covered of metal surface is exposed; it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.

All the fabricated frames, instrument racks, Junction box frame, trays/ impulse pipes, supports, panel base frame, etc., wherever applicable shall be after thoroughly cleaning the surface from dust, rust, greases, oils, scales, etc., by wire brush, scrapping, sand blasting/ shot blasting (as applicable) as specified in relevant erection documents. The above parts shall then be painted with specified two coats of specified paint over the shop primer/ paint. Also, where the shop primer/ paint has peeled off, the affected area shall be cleaned thoroughly by the specified method and then primer coat applied. Similarly, certain components may be supplied without any primer/ paint coat from shop. The surface of such items shall be cleaned as per specifications, coated with suitable primer and then coated with final paint coats. The dry film thickness after final coat should be as per specification. The color, shade etc. shall be as per specification. Painting schedule will be furnished at site. The quoted rates should be inclusive of all these including supply of paints and consumables.

All metal parts of the equipment including supports, structures, etc., as applicable shall be painted after thoroughly cleaning the surface from dust, rust, greases, oils, scales, etc., by wire brush, scrapping, sand blasting/ shot blasting (as applicable) as specified in relevant erection documents. The above parts shall then be painted with specified two coats of specified paint over the shop primer/ paint. Also, where the shop primer/ paint has peeled off, the affected area shall be cleaned thoroughly by the specified method and then primer coat applied. Similarly, certain components may be supplied without any primer/ paint coat from shop. The surface of such items shall be cleaned as per specifications, coated with suitable primer and then coated with final paint coats. The dry film thickness after final coat should be as per specification. The color, shade etc. shall be as per specification. Painting schedule will be furnished at site.

Other equipment like JBs, Panels, transmitter racks, Local gauge boards etc., shall be painted with two coats of synthetic enamel paint. The quoted rates should be inclusive of application of two final coats of synthetic enamel paint. All the consumables such as wire brush, other cleaning materials,

painting implements, etc., is to be arranged by the contractor at his own cost. All equipment painting will be done by spray painting. The quoted rates should be inclusive of all these including

All the weld joints of GI cable trays and GI structural members shall be applied with red oxide and aluminium paint and then coated with bitumen.

All damaged surfaces of galvanized or un-galvanized faces of steel structures etc. shall be brushed up and painted with red primer paint followed by two coats of aluminium paint/ enamel paint to the satisfaction of Engineer. The contractor has to arrange all the materials for painting at his cost.

Welded joints on GI earthing conductors shall be coated with one coat of bituminous paint in case of buried earth grid or earth flats to be laid in cable trench. For site welded GI strips/ wires which are exposed these are required to be painted with one coat of cold galvanizing zinc paint. Contractor to arrange the required paints and other items at his cost.

In case of GI Structure, the cold galvanizing paint to be applied as touch up where ever needed. This is to be done as per instruction of BHEL Engineer.

The primer shall be compatible with the final coat paint schedule.

Colour Banding, Legend and Identification Marking, Direction marking etc. shall be in scope of the contractor.

Impulse pipes shall be applied with one coat of primer red oxide paint and two coats of synthetic enamel of prescribed shade of final paint as instructed by BHEL Engineer/ painting schedule. BHEL may prescribe a time gap between first coat and second coat of final paint. Paint, primer, brush, etc. supply is in the scope of the contractor. Colour codes for impulse piping, etc. will be as per standard codes/ mother pipe.

The external & internal colour of the panels/ enclosures shall be RAL 7032 and brilliant white respectively. The panels shall have matt finish to prevent any glare surface due to illumination.

The primer shall be compatible with the final coat paint schedule.

Supply of paint, primers, other consumables etc. for above and any other scope in these specifications shall be in Contractor's scope.

Irrespective to scopes of painting & supply of paint mentioned elsewhere it is to be noted that supply of paint, primers, other consumables etc. for all primer/ painting works to be done by the contractor, shall be in Contractor's scope. No dispute shall be entertained on the above matter.

STRUCTURAL

Structural components may be supplied without any primer/ paint coat. The surface of such items shall be cleaned as per specifications and then coated with two coats of Primer.

PANELS, JUNCTION BOXES

Panels and Junction Boxes shall be Touch-up painted as and where original shop paint is peeled off.

Necessary surface cleaning and preparation shall be done by the contractor as per relevant painting codes followed by two coats of Primer and two coats of Finish Paint.

Sl. No	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
1.1	**ESTABLISHMENT**			
1.1.1	**FOR CONSTRUCTION PURPOSE**:			
a	Open space for office (as per availability)	Yes		Location will be finalized after joint survey with owner
b	Open space for storage (as per availability)	Yes		Location will be finalized after joint survey with owner
c	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
d	Bidder's all office equipments, office / store / canteen consumables		Yes	
e	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
f	Firefighting equipments like buckets, extinguishers etc		Yes	
g	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.1.2	**FOR LIVING PURPOSES OF THE BIDDER**			
a	Open space for labour colony (as per availability)		Yes	*Agency has to make his own arrangement at his own cost.*
b	Labour Colony with internal roads, sanitation, complying with statutory requirements		Yes	
1.2	**ELECTRICITY**			
1.2.1	**Electricity For construction purposes** of Voltage 415/440 V			***Chargeable****; Any penalty due to non-maintenance of power factor by the customer shall be passed on to the contractor.*

Sl. No	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
a	Single point source	Yes		Chargeable. The charges for the actual energy consumed by the Contractor shall be Recovered by BHEL based on the prevalent rate of DISCOM
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
1.2.2	**Electricity for the office, stores, canteen etc of the bidder**			*Agency has to make his own arrangement at its own cost.*
a	Single point source	Yes		
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
1.2.3	**Electricity for living accommodation of the bidder's staff, engineers, supervisors etc**			*Agency has to make his own arrangement at its own cost.*
a	Single point source		Yes	
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
1.3	**WATER SUPPLY**			
1.3.1	**For construction purposes**			*Agency has to make his own arrangement at its own cost.*
a	Making the water available at single point	Yes		
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	

Sl. No	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
1.3.2	**Water supply for bidder's office, stores, canteen etc**			
a	Making the water available at single point	Yes		
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.3	**Water supply for Living Purpose**			
a	Making the water available at single point		Yes	
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.4	**LIGHTING**			
a	For construction work (supply of all the necessary materials) 1. At office/storage area 2. At the preassembly area 3. At the construction site /area		Yes	
b	For construction work (execution of the lighting work/ arrangements) 1. At office/storage area 2. At the preassembly area 3 At the construction site /area		Yes	
c	Providing the necessary consumables like bulbs, switches, etc during the course of project work		Yes	
d	Lighting for the living purposes of the bidder at the colony / quarters		Yes	
1.5	**COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER**			
a	Telephone, fax, internet, intranet, e-mail etc		Yes	
1.6	**COMPRESSED AIR wherever required for the work**		Yes	
1.7	**Demobilization of all the above facilities**		Yes	
1.8	**TRANSPORTATION**			
a	For site personnel of the bidder		Yes	
b	For bidder's equipments and consumables (T&P, Consumables etc)		Yes	

Sl. No	Description PART II	Scope / to be taken care by		Remarks
		BHEL	Bidder	
1.9	**ERECTION FACILITIES**			
a	Providing the erection drawings for all the equipments covered under this scope	**Yes**		
b	Drawings for construction methods	**Yes**		*In consultation with BHEL*
c	As-built drawings – where ever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes		**Yes**	*In consultation with BHEL*
d	Shipping lists etc for reference and planning the activities	**Yes**		
e	Preparation of site erection schedules and other input requirements		**Yes**	*In consultation with BHEL*
f	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		**Yes**	*In consultation with BHEL*
g	Weekly erection schedules based on Sl No. e		**Yes**	*In consultation with BHEL*
h	Daily erection / work plan based on Sl No. g		**Yes**	*In consultation with BHEL*
i	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two weeks.		**Yes**	
j	Preparation of preassembly bay		**Yes**	
k	Laying of racks for gantry crane if provided by BHEL or brought by the contractor/bidder himself		**Yes**	
L	Arranging the materials required for preassembly		**Yes**	

Sl. No	Description PART II	Scope / to be taken care by		Remarks
		BHEL	Bidder	
m	HSE Permits, Approvals, Requirements		**Yes**	

4. Electricity Guidelines:

a) The construction power (415V) will be provided at a single point for construction purpose only at chargeable basis and the further distribution is to be arranged by the bidder at his cost. Construction power shall be provided from the nearest Substation / tapping point.

b) 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.

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

d) 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.

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

f) In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Customer.

g) Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Customer, he shall ensure:

1) Satisfy BHEL/Customer that the appliance is in good working condition.

2) Inform the BHEL/Customer of the maximum current rating, voltage and phase of the appliances.

3) Obtain permission of the BHEL/Customer detailing the socket to which the appliances may be connected. The BHEL/Customer will not grant permission to connect until he is satisfied that the appliance is in good condition and is fitted with a suitable plug.

4) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.

h) No repair work shall be carried out on any live equipment. The equipment must be declared safe by the BHEL/Customer and a permit to work issued before any work is carried out.

i) The Contractor shall employ the necessary number of qualified, full time electricians to maintain his temporary electrical installation.

3.2 WELDING PROCEDURE

The welding of all equipment, piping, pressure parts shall be in accordance with qualified welding procedures. The welders must be qualified in accordance with the latest applicable and statutory requirements.

3.2.1

Recommendation for Welded Joints (For Enclosure, Box Conductor, Make Up Pieces, Shunt and Flexible Joint etc.)

TYPE OF WELDING	MIG/ TIG WELDING
Filler Wire	1.6 mm dia. (NG 21 with 5% silicon)
Angle	10 to 15-degree foreheads.
Cleaning	Degrease and scratch brush.
Current Setting	Depend on thickness.

3.3 ERECTION CONDITIONS OF CONTRACT

The Bidder upon signing of the Contract shall, in addition to a Project coordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and coordination of the Works to be performed at Site. Such a person shall function from the Site office of the Bidder during the pendency of Contract.

3.4 ACCESS TO SITE AND WORKS ON SITE

3.4.1 Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the BHEL/Customer in reasonable time.

3.4.2 The execution of the Works, no person other than the Contractor or his duly appointed representative, and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the BHEL/Customer or his representative.

3.5 FACILITIES TO BE PROVIDED BY THE CUSTOMER

3.5.1 ELECTRICITY

The Contractor shall be provided with electricity **on chargeable basis** for the purposes of the Contract, only at one location in the Customer's Site and at 415V voltage level. The Contractor shall make his own further distribution arrangement. All temporary wiring must comply with local

regulations and will be subject to Customer's inspection and approval before connection to supply. The free supply of power will not be provided for the use in the labor and staff colony.

3.5.2 WATER

Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labor and other personnel at the worksite/colony. Customer shall provide water at single point.

3.6 FACILITIES TO BE PROVIDED BY THE CONTRACTOR

3.6.1 Contractor's site office Establishment: The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract.

3.6.2 Contractor shall obtain **all required statutory approvals like labor license, safety training & insurance, etc.**

3.6.3 Contractor shall deploy labor workers whose police verification is carried out. Contractor has to give under taking for the same while obtaining the gate pass. Contractor has to submit police verification record of his labour /workers to Dy. Commandant, CISF, Customer office/A.D. Security, TPS.

3.6.4 Contractor shall obtain gate pass with receipt of work order & start the work as per directives of contract operating authority, otherwise action as deemed fit shall be taken against Contractor.

3.7 TOOLS, TACKLES AND SCAFFOLDINGS

The Contractor shall provide all the construction equipment, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning of the equipment covered under the Contract. He shall submit a list of all such materials to BHEL/Customer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the BHEL/Customer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, truck, etc. for the purpose of fabrication, dismantling, erection and commissioning, and material management to and from the site.

3.8 CLEANLINESS

3.8.1 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Customer. Materials and stores shall be so managed to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

3.8.2 Similarly, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.

3.8.3 SECURITY

The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Site only with the written permission of the BHEL in the prescribed manner.

3.9 COMMISSIONING ACTIVITIES

3.9.1 Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of equipment/systems. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the equipment/systems.

3.9.2 Contractor shall carry out the checks/tests at site, according to instructions of BHEL engineer, to prove to the Customer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.

3.9.3 Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the BHEL/Customer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence. Decision of BHEL engineer shall be final and binding on contractor.

3.9.4 Other tests shall be conducted, if required by the BHEL/Customer, to establish that the plant equipment are in accordance with requirements of the specifications.

3.9.5 The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipment including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and
Installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.

3.10 MATERIALS HANDLING AND STORAGE

3.10.1 Contractor after issue of material shall be responsible for examining all the shipment and notify the BHEL/Customer immediately of any damage, shortage, discrepancy etc. for the purpose

of BHEL/ Customer's information only. However, the Contractor after receipt/issue of material shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment to and from the site.

3.10.2 All electrical panels, controls gear and such other devices shall be properly dried by heating before they are installed and energized. Exposed parts shall be protected against moisture ingress and corrosion during storage at site after issue to the contractor and periodically inspected.

3.10.3 The Contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storage are removed before the equipment are installed.

3.10.4 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

3.10.5 After issue all the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.

3.10.6 If the materials belonging to the Contractor are stored in areas other than those earmarked for him, BHEL will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.

3.11 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

3.11.1 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the BHEL/Customer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipment and utilities either above or below the ground.

3.11.2 The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property.

3.11.3 The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of Customer and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time.

3.12 FOUNDATION DRESSING, GROUTING AND DOWELLING

3.12.1 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations. All the equipment/ equipment bases shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer. The concrete foundation surfaces shall

be properly prepared by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.

3.12.2 Grout

The grout shall be high strength grout having a characteristic compressive strength as per standard for equipment.

3.12.3 DOWELLING

All the turbine supervisory sensors and other equipment shall be suitably doweled with tapered machined dowels as per the standards and direction of the BHEL/Customer

3.13 Equipment Installation

a) General Requirements

i) The Contractor shall furnish all construction materials, tools and equipment other than that being supplied by BHEL and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification. This clause is to be read in conjunction with relevant clauses, instructions, guidelines etc. mentioned elsewhere in this document.

(ii) Contractor shall prepare Marked-Up drawings incorporating modifications and deviations from original drawings or prepare fresh sketch for actual installation/ connection details if need be, that can be converted to "As-built" drawings.

iii) The Contractor shall coordinate his work with other suppliers/contractors where their instruments and devices are to be installed under specifications.

b) **Regulatory Requirements**

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

c) **Equipment Assembly**

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.

d) **Equipment Setting**

Field mounted instruments and accessories, other than those in local instrument enclosures/racks, shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level or as instructed by BHEL engineer. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level or as instructed by BHEL engineer.
All free-standing instrumentation cabinets and panels shall be located within the construction tolerances of +/- 3 mm of the location dimensions indicated on the Customer's plant arrangement drawings or as per recommendation/instruction of BHEL engineer.

e) Free-Standing Equipment

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on relevant drawings/documents. The cabinets shall be shimmed for proper alignment before bolting them to the floor or welding of base frame as required. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

f) Non-Free-Standing Equipment:

i) Non-free-standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Customer's Plant Arrangement Drawings or as per instruction of BHEL engineer which shall be final and binding on contractor. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner

ii) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished as per painting schedule previously mentioned.

g) Equipment Location:

(i) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the BHEL/Customer.

(ii) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.

(iii) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished, other than that being supplied by BHEL and installed.

h) Equipment Checkout

(i) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

(ii) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

i) Defects

(i) All defects in erection shall be corrected to the satisfaction of the BHEL/ Customer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.

NOTE:

1. DEFECT LIABILITY PERIOD SHALL BE 24 MONTHS FROM THE DATE OF SYNCRONIZATION OF UNIT.

j) Equipment Protection

(i) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

(ii) The equipment shall be protected during storage as described herein.
(iii) Equipment shall be protected from weld spatter during construction.
(iv) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

(v) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.

(vi) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type and rust preventive compound.

3.14 DEVIATIONS DISPOSITIONING:

Any deviation to the contract and BHEL/ Customer approved documents shall be properly recorded. All the deviations shall be brought to the knowledge of BHEL representative for suitable disposition.

3.15 Bidder is to provide one office boy in each shift for BHEL Office.

3.16 ARRANGEMENT OF SAFETY ENGINEERS ALONG WITH COMPLIANCE OF ALL HSE REQUIREMENTS: -

1) Two (02) Nos Safety Engineers are to be deployed by the contractor for complete duration of R&M works in consultation with BHEL Site-In-Charge. Safety Engineer should be qualified from approved institute. Certificate shall be produced at the time of deployment.

2) Bidder has to fulfil all HSE related requirement at site.
3) In Addition to BHEL safety conditions in tender, Bidder has to fulfill Customer safety norms at site **(Kindly Refer Annexure-B)**

3.17 ARRANGEMENT OF C&I and Electrical EXPERTS: -

Two (02) Nos. C&I experienced experts and One (01) No. Electrical expert are to be deployed by the contractor for complete duration of R&M works with prior approval of BHEL.

3.18 ARRANGEMENT OF QUALITY ENGINEERS: -

Two (02) Nos Quality Engineers are to be deployed by the contractor for complete duration of R&M works in consultation with BHEL Site-In-Charge. Quality Engineer should be qualified from approved institute. Certificate shall be produced at the time of deployment.

A: TOOL & PLANTS

List of major testing & measuring equipment/ tools and tackles to be arranged/ brought by contractor.

Sr. No.	Description	UoM	Qty
1	DC power supply 0-250 V, 10 A make "Aplab" or equivalent (variable source)	Nos.	4
2	DC shunt 400 A 75 mV	Nos.	As required
3	Dead weight tester rated 400 kg/ cm^2 and with weights and test gauge facility. Make 'Budenberg' or 'Ravika'	Nos.	As required
4	Decade resistance box	Sets	4
5	Digital Tong tester AC 5/ 10 and 25/ 60/ 300 A of reputed make	Nos. Each	2
6	Digital Tong tester DC 30/ 60/ 300 A	Nos.	1
7	Earth Resistance Tester	Nos.	1
8	Equipment and consumables for LPI/ MPI test on impulse pipes	Sets	As required
9	Ferrule printing machine	Nos.	2
10	Fire proof tarpaulin		As required
11	Function Generator	Nos.	1
12	Glass thermometer 0-120 °C, 0-200 °C and 0-600 °C	Nos. Each	As required
13	Inclined manometer (+/ -) 300 mm water column	Nos.	2
14	Industrial type vacuum cleaner	Nos.	2
15	Insulation Tester Hand Operated 250V/ 500V/ 1000V rated mains/ battery operated	Nos.	2
16	Insulation Tester Hand Operated 250V/ 500V/ 1000V rated mains/ battery operated	Nos. Each	2
17	Manometers (+/ -) 500 mm mercury column with hand bulb for lab and small manometer for field purpose.	Nos.	As required
18	Muffle furnace – 800 °C with standard temperature gauges	Nos.	As required
19	Multimeters		
	A) Digital, 3 1/ 2 digit Motwane/ HIL/ Fluke or any reputed make	Nos.	4
	B) Digital, 4 1/ 2 digit Motwane/ HIL/ Fluke or any reputed make	Nos.	4
20	Oil temperature bath suitable to calibrate the instruments range 0 – 200 °C with standard temperature gauges and thermostatic control	Nos.	As required
21	Portable air compressor with drier and regulator make "Toshniwal/ Khosla" or any reputed make rated for 7 to 10 kg/ cm^2	Nos.	As required

22	Rheostat	Nos.	2
23	RTD/ Pt 100 source	Nos.	2
24	Single Phase Variac 250 V, 8 A	Nos.	2
25	Soldering iron "Soldron" make 25 W	Nos.	2
26	Standard gauges 12" dial size make "Budenberg" or "H Guru" or "Odin" or any reputed make		
	A) –1– 0 kg/ cm^2 pressure gauge(vacuum gauge)	Nos.	2
	B) 0 – 5 or 6 kg/ cm^2 pressure gauge	Nos.	2
	C) 0 – 10 kg/ cm^2 pressure gauge	Nos.	2
	D) 0 – 25 kg/ cm^2 pressure gauge	Nos.	2
	E) 0 – 60 kg/ cm^2 pressure gauge	Nos.	2
	F) 0 – 100 kg/ cm^2 pressure gauge	Nos.	2
	G) 0 – 250 kg/ cm^2 pressure gauge	Nos.	2
	H) 0 – 600 kg/ cm^2 pressure gauge	Nos.	2
	I) 0.2 to 1 kg pressure gauge	Nos.	2
27	Standard milliamps/ millivolts source of reputed make. Range 0 to 60 mA and 0 to 100 mV	Nos.	2
28	Temperature Gun Digital Type	Nos.	1
29	Three Phase Variac 05 A	Nos.	2
30	Vacuum Pump	Nos.	2
31	250V/500V/1000/5000V rated Hand operated megger Mains/battery operated		As required
32	Digital Megger		As required
33	Insulation tester mains operated 2500/5000V		As required
34	Earth resistance tester		As required
35	HV Test Kit		As required
36	Wheatstone bridge		As required
37	Micro ohmmeter		As required
38	Torque wrench (12-60 Nm,50-225 Nm)		As required
39	Dial gauges		As required
40	Primary current injection kit		As required
41	Secondary current injection kit up to 300 amp		As required
42	Digital Tachometer non-contact type 0 to 4000 rpm		As required
43	Relay testing kit		As required
44	DC Ammeter		As required
45	DC Voltmeter		As required
46	Voltmeter AC		As required

47	Ammeter AC		As required
48	Oil specific gravity and PPM measuring equipment		As required
49	Dew point measurement instrument		As required
50	Oscilloscope		As required
51	Electric blower		As required
52	Three phase distribution board with complete setup for drawl & distribution of construction power		As required
53	Electric cables for drawl & distribution of construction power, heating machines		As required

HANDLING EQUIPMENTS

S. No.	Description	UoM	Qty
1	Trailer along with pulling unit		As required
2	Mobile Cranes, trucks etc. for transportation and erection of equipment		As required
3	Hydraulic Lifting Machine /Hydraulic Jacks/ Pallet Truck of 5 Ton Capacity	Nos.	02
4	D-shackles		As required
5	Manila ropes		As required
6	Nylon Slings		As required
7	Steel wire ropes		As required
9	Chain pulley block/ turfer		As required
10	Turn buckles		As required
11	Oil filtration machine and tank		As required
12	Transformer oil testing kit		As required

MAJOR T&Ps

1	24V AC Transformer & Hand lamps	Nos.	10
2	Cable Rollers		As required
3	Chain Pulley Blocks 5/ 10 T	Nos. Each	2
4	Copper tube bender and cutter sizes 6mm, 8mm, 1/ 2”, 1/ 4”	Nos. Each	3
5	Crimping tool up to all sizes of Cables under scope of work	Nos. Each	10
6	Hydraulic crimping tool		As required
7	Die sets for threading up to 2” pipe.	Nos.	4
9	Distribution boards with power cable complete as required		As required
10	Drilling machines		As required
11	Electrician tool kit	Sets	14
12	Electrode drying ovens		As required
13	Ferrule printing machine	Nos.	2

14	Fire extinguishers (Type: as required)	Nos.	5
15	Fire proof tarpaulin		As required
16	Flood light fittings	Nos.	10
17	Grinding machine	Nos.	10
18	Measuring instruments like Micrometres and Callipers	Sets Each	2
19	Mechanical tool kit for fitters	Sets	10
13	Painting brush		As required
14	Personal computer and accessories, Printer	Sets	1
15	Pipe bending machine – 2" size	Nos.	4
16	Safety belts (Full body Safety Harness) and Safety helmets		As required
17	Spirit level	Nos.	4
18	Tap sets for both BSP and MPT threads up to 1" each	Sets Each	2
19	TIG Welding Set	Nos.	4
20	Welding Generators		As required
21	Welding Transformers		As required

The following materials/ consumables are to be arranged by the contractor as part of the contractual scope.

S. No.	Description
1	Welding electrodes for welding AS/ CS/ SS pipe and other welding from BHEL approved vendors only
2	Filler wire for argon welding
3	Argon, oxygen and acetylene gas
4	Provision for temporary scaffoldings.
5	GI "U" clamps with nuts and washers for impulse and GI pipe clamping.
6	Round aluminium tags (30mm dia. x 3mm thick)
7	Teflon tape and insulation tape.
8	Hold tight/ bitumen tape for GI pipe coupling.
9	Required paints and primer from BHEL approved vendors only.
10	Solder wire (60/ 40)
11	Protocol/ calibration report sheets as per BHEL format.
12	Panel/ JB sealing compound material (for cable entry from bottom/ top of panel).
13	PVC cable tie, aluminium strip and hardware for clamping of cables, copper tube, and temperature gauge capillary.
14	Copper lugs up to 4 sq. mm, PVC sleeve of different size, PVC button & tape
15	Ferrules (PVC) and suitable for ferrule printing.
16	Saddle GI & Saddle Epoxy
17	Checknut GI & Checknut Epoxy
18	Inspection bend GI & Inspection bend Epoxy
19	Solid bend GI & Solid bend Epoxy
13	Circular Boxes GI & Circular Boxes Epoxy

14	Ball & Socket
15	Nylon Grips
16	Wooden Screw & Machine Screw
17	Reducer, PVC Brush & Sleeves
18	Cu Lugs , Earth Clip, Anchor Fastener , Ferrules, Flexible Coupler
19	Flexible rod & Cu clad rod for pole earthing
20	GS Flat 'U' Clamps for pole JB fixing
21	GI Bolts 'U' Clamps fixing
22	GI Conduit sleeves
23	GI bolts & Nuts for Fixture & CG box fixing
24	GI bolts & Nuts with washers for panels
25	Primer & Oxide paint for pole & MS structure painting
26	Aluminium paint for pole & MS structure painting

NOTES:	
1	The above list is only indicative and these T&Ps may not be required for entire contract period but contractor shall ensure the availability of the T&Ps as per work requirement and T&P Deployment schedule. T&P Deployment schedule shall be finalized at site in consultation with BHEL Engineer based on the work fronts/work requirement. BHEL decision shall be final and binding regarding the T&P deployment schedule. Contractor shall mobilize / maintain the T&P's as per the deployment schedule notified time to time by BHEL Engineer.
2	As Required- Contractor has to deploy T&P, MMD, IMTE as per requirement of site and as decided by BHEL Engineer.
3	If any one of T&P mentioned above is not needed for proper execution of scope of work, provided contractor has not utilized BHEL free issued T&P for completing such work, no recovery from contractor shall be applicable.
4	Any additional item required in addition to above mentioned T&P for proper execution of scope of work, contractor has to arrange such T&P within quoted rate on the instruction of BHEL in writing in a reasonable period within two weeks from the written instruction from BHEL.
5	i.) In case deployment of T&P w.r.t requirement/schedule, is delayed or deployed for a shorter period or abnormal down time of T&P or ii) in case T&P w.r.t requirement was not deployed by the contractor as per instruction of BHEL and BHEL had to deploy either its own T&P or iii.) BHEL had to deploy the T&P from outside agency, then recovery shall be done from the contractor as under:
5.1	In case BHEL had to deploy its own T&P, hire charges of T&P applicable for outside agencies as per extant guidelines for "Hire Charges on issue of Capital Tools & Plants" shall be recovered.
5.2	In case BHEL had to deploy the T&P from outside agency, actual hiring cost plus applicable overheads shall be recovered

6	All the tools and tackles/measuring instruments shall be duly tested/calibrated and valid certificate to that effect should be submitted to BHEL site in-charge before the start of work.
7	T&P's mentioned above shall be specifically deploy as per the respective packages. However, as per work requirement and availability of T&Ps the inter use in Material Handling and Mechanical works may be permitted as per the instruction of the BHEL Engineer.
8	If the work related to T & Ps mentioned above is completed then, BHEL can release that T & P during contract period / extended period if any. However, written permission shall be taken by contractor from BHEL construction Manager for releasing the T&P.
9	T&P required for civil work shall be in the scope of bidder.
10	**Other than the aforesaid, one computer, printer and other necessary peripherals will have to be maintained by the contractor in his site office.**

List of T&P/instruments and consumables that will be made available by BHEL free of hire charges (on sharing basis).

1	EOT crane in TG hall shall be made available on sharing basis for handling panels	

Note: -

Skilled EOT Crane operators, for round the clock working is in bidder's scope.

Above T&P will be provided on sharing basis only. Contractor has to plan his activities well in advance and inform BHEL Engineer in charge/ Construction Manager the date of actual use. The decision of BHEL Engineer in-charge/ CM on this will be final and binding.

Various agencies shall be working at same plant thus Bidder has to work in co-ordination with other agencies.

6.0 TIME SCHEDULE AND MOBILIZATION:

6.1 TIME SCHEDULE & MOBILIZATION

6.1.1 INITIAL MOBILIZATION AND TENTATIVE SCHEDULE

AFTER RECEIPT OF FAX/ EMAIL LOI, CONTRACTOR SHALL DISCUSS WITH PROJECT MANAGER/ CONSTRUCTION MANAGER REGARDING INITIAL MOBILIZATION. CONTRACTOR SHALL REACH SITE, MAKE HIS SITE ESTABLISHMENT **AND BE READY TO COMMENCE THE ERECTION WORK WITHIN 03 DAYS FROM THE DATE OF ISSUE OF LETTER** OF INTENT OR AS PER THE DIRECTIONS OF CONSTRUCTION MANAGER/ PROJECT MANAGER OF BHEL.
ALL RESOURCES SHALL BE MOBILISED WITHIN 03 DAYS TO MATCH THE SCHEDULE OF MILESTONES AND COMMISSIONING.

SHUTDOWN WORKS:
Completion of Erection & Commissioning (up to first synchronization of Unit) of Electrical System and Unified Distributed Digital Control Monitoring & Information System (DDCMIS) for Renovation & Modernization of complete Boiler and Turbine Auxiliaries in SHUTDOWN PERIOD.

SHUTDOWN PERIOD:
a) Entire E&C works are to be completed within 45 Days from the date of Start of work.
b) **Total Work completion time for shutdown shall be 45 days (from the date of start of work till Unit full load).**
c) **PG Test and Demonstration:** within 08 weeks from the date of completion of continuous 48 hrs of trial run.

SHUTDOWN SCHEDULE: UNIT IS CURRENTLY UNDER SHUTDOWN.

6.2 Contract Period
The total Contract Period shall be 45 Days.

6.3

The contractor should reach site and establish his site office and mobilize to commence the work as per directions of BHEL engineer. The date of starting the work at site shall be fixed in consultation with BHEL's engineer and the same will be recorded in measurement book while entering the first RA bill.

6.4

Contractor shall draw the periodic (weekly.) erection programme along with BHEL engineer indicating the work to be achieved and event to be completed. Once the programme is drawn, he shall adhere to the same. Contractor shall plan and erect the materials as it is received at site. The monthly/weekly planned percentage shall take into consideration the material

available at site before the start of the month/week and also any material received during the month. Contractor shall mobilize his resources required to achieve the monthly programmes.

6.5 DEFINITION OF WORK COMPLETION

The contractor's scope of work under these specifications will be deemed to have been completed in all respect, only when all the activities are completed satisfactorily and so certified by BHEL site in charge. The decision of BHEL in this regard shall be final and binding on the contractor.

6.6 MATERIAL RECONCILIATION

The contractor shall do material re-conciliation periodically.

The progressive payment for dismantling, erection, testing and commissioning on accepted price of contract value for Electrical and C&I Package rates will be released as per the break up given hereinafter:

	TERMS OF PAYMENT	
Sl. No.	**Activity/Work Description**	**% of unit rate**
A	**Main E&C Equipment/Items**	
(I)	**PRO RATA PAYMENTS (85%)**	
	SECTION-A/ BALANCE WORKS	
1.0	**Cable tray and accessories**	
1.1	Fabrication and fixing/welding/bolting in position	60%
1.2	Earthing of cable trays	15%
1.3	Tagging of cable trays (painting cable tray numbers on sides)	5%
1.4	Covering of trays where ever envisaged	5%
	Total =	**85%**
2.0	**Cable laying (Instrumentation Cables)**	
2.1	Laying of cables	45%
2.2	Glanding, Termination and tagging of cables	15%
2.3	Dressing and clamping of cables	10%
2.4	Shielding of cables	5%
2.5	Testing and charging of cables	10%
	Total =	**85%**
3.0	**Cable laying (Power Cables)**	
3.1	Laying of cables	45%
3.2	Glanding, Termination and tagging of cables	15%
3.3	Dressing and clamping of cables	10%
3.4	Testing and charging of cables	15%
	Total =	**85%**
4.0	**Junction box/Push button station (local)**	
4.1	Erection including fixing of terminal blocks where ever applicable	75%
4.2	Name plate fixing where ever applicable, Labelling (both inside and outside) and Commissioning of connected equipment	10%
	Total =	**85%**
5.0	**Panels/Cubicles/Desks/Racks/Enclosures/Monitors/Computers/Computer peripherals/PLCs/UPS/Batteries**	
5.1	Erection and alignment	50%
5.2	Fixing of loose items/instruments where ever applicable	5%

5.3	Pre-commissioning checks, Charging of panel and Loop testing etc	15%
5.4	System commissioning	15%
		85%
6.0	**Instruments/Devices including Sensors/Cells/Probes etc**	
6.1	Removal & refixing/Fixing loose supplied components, including tubing/hose, regulators, etc	30%
6.2	Calibration/Local testing - commissioning readiness	30%
6.3	Local Commissioning & Loop Testing as required	10%
6.4	System Commissioning or Remote Commissioning as required	15%
	Total =	**85%**
7.0	**HMI**	
7.1	Erection and alignment	50%
7.2	Fixing of loose items/instruments where ever applicable	5%
7.3	Pre-commissioning checks, Charging and Loop testing etc	15%
7.4	System commissioning	15%
		85%
8.0	**Flame Scanner**	
8.1	Erection and alignment	50%
8.2	Fixing of loose items/instruments where ever applicable	5%
8.3	Pre-commissioning checks, and Loop testing etc	15%
8.4	System commissioning	15%
		85%
9.0	**Conduits/impulse pipe/tubes**	
9.1	Fabrication, Laying and Erection	50%
9.2	Leak Test/Hydraulic Test (where ever applicable, otherwise clubbed with next activity)	20%
9.3	Dressing, clamping, tagging and painting where ever applicable	8%
9.4	Testing & commissioning of associated equipment/system	7%
	Total =	**85%**
10.0	**Commissioning and Testing activities for equipments erected by other agencies like Control Valves, On/Off Valves, Electrical/Pneumatic Valves, Actuators, Solenoid Valves, Valves, Limit Switches, ERV Controllers, Power Cylinders, Pressure and Temperature Gauges, Transmitters etc.**	
10.1	Removal & re-fixing/Fixing loose supplied components, including tubing/hose, regulators, etc.(where ever applicable, otherwise clubbed with next activity)	30%
10.2	Calibration/ Local testing - commissioning readiness	30%
10.3	Local Commissioning & Loop Testing as required	15%
10.4	System Commissioning or Remote Commissioning as required	10%

	Total =	**85%**
11.0	**Miscellaneous Structural steel including frames for Panels/Racks/Instruments, supports for cable tray/pipes/tubes, Canopies etc**	
11.1	Fabrication, Erection, Alignment, Welding/bolting and where ever applicable chipping/grouting/painting	65%
11.2	Erection of associated Items/Equipment/Systems as applicable	20%
	Total =	**85%**
12.0	**Above Ground Earthing & Lightning Protection Materials**	
12.1	Fabrication, erection, alignment, welding/ bolting of earthing/ lightning protection strips; earth pits completion	60%
12.2	Testing/commissioning/Connection to equipment	25%
	Total =	**85%**
13.0	**Dismantling**	
13.1	Old cable removal and Dismantling of existing DCS Panels from Site.	40%
13.2	Shifting of existing/old Panels from site to Customer's store/designated area.	20%
13.3	Disconnection, Reconnection of existing cables	15%
13.4	Completion	10%
	Total =	**85%**
14.0	**Civil Works**	
14.1	Modification in cut-out, making holes, breaking concrete floors etc	50%
14.2	Finishing	10%
14.3	Clean-up	15%
14.4	Completion	10%
	Total =	**85%**
15.0	**Electrical**	
15.1	Erection & Alignment	50%
15.2	Fixing of loose items/instruments where ever applicable	10%
15.3	Pre-commissioning/Testing	15%
15.4	Commissioning/Completion	10%
	Total =	**85%**
16.0	**SECTION-B/ ADDITIONAL WORKS**	
16.1	Erection & Alignment	50%
16.2	Fixing of loose items/instruments where ever applicable	10%
16.3	Pre-commissioning/Testing	15%
16.4	Commissioning/Completion	10%
	Total =	**85%**

(II) STAGE/MILESTONE PAYMENTS (15%)

Boiler Light Up	1%
Rolling and Synchronisation	1%
Coal Firing	1%
Full Load	1%
Area cleaning, temporary structures cutting/removal and return of scrap	2%
Punch List points/pending points liquidation	2%
Material Reconciliation	1%
Completion of Contractual Obligation	1%
Arrangement of Quality & Safety engineers along with compliance of all HSE requirements	2%
Arrangement of C&I and Electrical Experts (Qty-03) (i.e 1% for Each Expert)	3%
Total for Milestone/Stage payments (15%)	**15%**
OTHERS	
Laboratory Instruments installation and demonstration where ever applicable	100%
PG Test Instruments installation (50%) and removal (50%)	100%

8.0 TAXES, DUTIES, LEVIES (Rev 14 dated 09/10/2020)

1. All taxes excluding GST, GST Cess **& BOCW** Cess **but including, Royalties, fees, license, deposits, commission, any State or Central Levy and other charges whatsoever, if any, shall be borne by you and shall not be payable extra.**
2. Any increase of the taxes excluding GST, GST Cess & BOCW **Cess**, at any stage during execution including extension of the contract shall have to be borne by the contractor. Quoted/ accepted rates/ price shall be inclusive of all such requirements. Please note that since GST on output will be paid by BHEL separately as enumerated below, your quoted rates/ price should be after considering the Input Credit under GST law at your end.
3. **GST :**

   The successful bidder shall furnish proof of GST registration. GST along with Cess (as applicable) legally leviable & payable by the successful bidder as per GST Law, shall be paid by BHEL. Hence Bidder shall not include GST along with Cess (as applicable) in their quoted price.
4. GST charged in the Tax Invoice/Debit note 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
5. E-invoicing under GST has been implemented with effect from 1st October 2020 for all the taxable persons having turnover more than the threshold limit in any preceding financial year from 2017-18 onwards. Therefore, for all the taxable persons falling under the purview of E-invoice, it is mandatory to mention a valid unique Invoice Reference No. (IRN) and QR code as generated from E-Invoicing portal of the Government for the purpose of issuing a valid Tax Invoice. Only an E-invoice issued in the manner prescribed under rule 48(4) of CGST Rules shall be treated as valid invoice for reimbursement of GST amount.

   If the successful Bidder is not falling under the purview of E-Invoicing then he has to submit a declaration in that respect along with relevant financial statements.
6. Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred there under) wherein the 'Bill To' details will as below:

   BHEL GSTN – As per **Annexure -1**

   NAME -- Bharat Heavy Electricals Limited

   ADDRESS – Site address
7. Bidder to immediately intimate on the day of removal of Goods (in case of any supply of goods) to BHEL along with all relevant details and a scanned copy of Tax Invoice to below email ids to enable BHEL to meet its GST related compliances :-

   Email id ---- to be intimated later on.

   In case of delay in submission of the abovementioned documents on the date of dispatch, BHEL may incur penalty /interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from the successful bidder, if such delay is not attributable to BHEL.

8. In case of raising any Supplementary Tax Invoice (Debit / Credit Note) Bidder shall issue the same containing all the details as referred to in Section 34 read with Rule 53.
9. Bidder shall note that in case GST credit is delayed/ denied to BHEL due to delayed / non receipt of goods and /or tax invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons not attributable to BHEL, GST amount shall be recoverable from the vendor along with interest levied / leviable on BHEL, as the case may be.
10. Bidder shall upload the Invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law , GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the bidder along with interest levied / leviable on BHEL.
11. Way Bill: Successful Bidder to arrange for way bill / e-waybill for any transfer of goods for the execution of the contract.

    The Bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the works under this contract, Road Permit/ Way Bill, if required, shall be arranged by the contractor and BHEL will not supply any Road Permit/ Way Bill for this purpose.
12. **New taxes and duties**:-Any New taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period including extension, if the same is not attributable to you, shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties.

    Benefits and/or abolition of all existing taxes must be passed on to BHEL against new Taxes, if any, proposed to be introduced at a later date.

    In case any new tax/levy/duty etc. becomes applicable after the date of bidder's offer but before opening of the price bid, the bidder must convey its impact on his price duly substantiated by documentary evidence in support of the same before opening of the price bids. Claim for any such impact after opening the price bid will not be considered by BHEL for reimbursement of tax or reassessment of offer.

13. For transportation work, bidder shall declare in his quotation whether he is registered under GST, if yes, whether he intends to claim GST on forward charge basis. In absence of this declaration, BHEL will proceed further with the assumption that bidder intends not to claim GST on forward charge basis. However, in case of GST registered transporter, the amount to the extent of goods and service tax will be retained till BHEL avails the credit of GST. Further, transporter shall issue tax invoice which inter alia includes gross weight of the consignment, name of the consigner and the consignee, registration number of vehicle in which the goods are transported, details of goods transported, details of place of origin and destination, GSTIN of the person liable for paying tax whether as consigner, consignee or goods transport agency, and also containing other information as mentioned under rule 46.

14. **TDS under Income Tax shall be deducted at prevailing rates on gross invoice value from the running bills unless exemption certificate from the appropriate authority/ authorities is furnished.**

15. **TDS under GST shall be deducted at prevailing rates on applicable value from the running bills.**

16. **TCS under Income Tax 1961 has been implemented with effect from 1st October 2020 for every seller having turnover more than threshold limit during financial year immediately preceding financial year in which the sale of goods is carried out, who receives any amount as consideration for sale of any goods of the value or aggregate of such value exceeding threshold limit other than export of goods or who is already covered under other provision of section 206C, collect from the buyer, TCS as per applicable rates of the sale consideration exceeding threshold limit subject to following conditions**
    i. Buyer shall be as per clause (a) of section 206C- (1H)
    ii. Seller shall be as per clause (b) of section 206C- (1H)
    iii. No TCS is to be collected, if the seller is liable to collect TCS under other provision of section 206C or the buyer is liable to deduct TDS under any provision of the Act and has deducted such amount.

    If Successful Bidder is falling under the purview of TCS then he has to submit a declaration in that respect along with relevant financial statements before the start of work or if bidder is falling under preview of TCS during the work in progress then bidder is compulsorily required to submit relevant financial statement in the beginning of the respective FY.

    For TCS claim, vendor has to submit relevant documents required as per Income Tax Act.

17. Refer Annexure – 2 for BOCW Act & Cess Act.

ANNEXURE-1

State wise GSTIN no.s of BHEL

Sl. No	Projects under state	GSTIN
1	Andhra Pradesh	37AAACB4146P7Z8
2	Bihar	10AAACB4146P1ZU
3	Chhattisgarh	22AAACB4146P1ZP
4	Gujarat	24AAACB4146P1ZL
5	Jharkhand	20AAACB4146P5ZP
6	Madhya Pradesh	23AAACB4146P1ZN
7	Maharashtra	27AAACB4146P1ZF
8	Orissa	21AAACB4146P1ZR
9	Telangana	36AAACB4146P1ZG

1. SPECIFIC INCLUSIONS

SPECIFIC INCLUSIONS MATRIX

Sr. No.	Description	Scope/ to be taken care by		Remarks
		BHEL	Bidder	
1	Lugs up to 4 sq. mm size	-	**Yes**	
2	Lugs beyond 4 sq. mm size	**Yes**	-	**For GI wire earthing**
3	Paint, primer and consumables		**Yes**	
4	LT cable straight through jointing Kits		**Yes**	
5	HT Termination Kits	**Yes**	-	
6	Clamps with hardware (Trefoil explicitly mentioned in BOQ)	**Yes**	-	**For single core HT cable**
7	Clamps with hardware		**Yes**	**As per requirement for LT cables**
8	Identification tags/ name plates with, PVC/ metals, sleeve and clamps with hardware for cables at both end and field instruments. PVC ties, Buttons and tap		**Yes**	
9	Steel for fabrication	**Yes**	-	
10	Cable ferruling numbers and characters.	-	**Yes**	
11	Cable Markers	-	**Yes**	
12	Paint, primer and consumables.		**Yes**	

NOTE: The aforesaid inclusions should not be construed as exhaustive. 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 should carry out all such jobs as per the instructions of BHEL Engineer.

10.1 BILL OF QUANTITIES (BOQ)

SECTION-A BALANCE WORK DETAILS

SECTION - A			
JOB Description: Balance Electrical and C&I works of Ukai R&M Unit-3 (200 MW) GSECL Ukai TPS.			
Sr. No.	**Description of Items**	**UOM**	**Qty**
1	**Cable Tray and Accessories- Complete with Coupler Plates, Fasteners, Clamps and Fixing Hardwares etc. Erection including Support and Covers**		
1.1	Galvanised Ladder Type Cable Tray, W=600mm	Meter	100.0
1.2	Galvanised Ladder Type Cable Tray, W=300mm	Meter	150.0
1.3	Galvanised Ladder Type Cable Tray, W=150mm	Meter	150.0
1.4	Void		
1.5	Perforated cable tray and accessories (with or without cover) 300mm	Meter	150.0
1.6	Perforated cable tray and accessories 1 (with or without cover) 150mm	Meter	500.0
1.7	Perforated cable tray and accessories (with or without cover) 100mm	Meter	200.0
1.8	Perforated cable tray and accessories (with or without cover) 50mm	Meter	600.0
2	**Instrumentation Cables**		
2.1	Screened Copper Cable 2P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	3000.0
2.2	Screened Copper Cable 4P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	15000.0
2.3	Screened Copper Cable 8P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	5000.0

2.4	Screened Copper Cable 12P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	2000.0
2.5	Screened Cable 4P x 1.5 sqmm armoured / unarmoured	Meter	2000.0
2.6	Thermocouple Cable: 2PX0.5 sqmm,Kx Type ''K'' Type Extension Cable unarmoured/armoured	Meter	6500.0
2.7	Co-Axial Cable for IRIG-B Signal Communication for master clock system	Meter	1000.0
2.8	Flame Scanner Cable- P/O Shielded	Meter	1000.0
2.9	Network UTP Cables in flexible GI pipes (special termination using UTP connectors involved)	Meter	600.0
3	**Power Cables**		
3.1	1CX630, Al, XLPE, PVC-FRLS, Arm, 1100 V	Meter	1600.0
3.2	1C-400 ARMOURED	Meter	600.0
3.3	2CX95 sq.mm, Cu, XLPE, PVC-FRLS, Arm	Meter	220.0
3.4	2CX2.5 sq.mm, Cu, XLPE, PVC-FRLS, Arm	Meter	3000.0
3.5	3CX95 sq.mm, Al, XLPE, PVC-FRLS, Arm	Meter	100.0
3.6	3CX25 sq.mm, Al, XLPE, PVC-FRLS, Arm	Meter	400.0
3.7	3C-16 ARMOURED	Meter	600.0
3.8	3C x 2.5 sqmm armoured control cable	Meter	12000.0
3.9	5CX2.5 sq.mm,Cu, PVC-FRLS, U/A, 1100 V/Armoured Cable	Meter	3500.0
3.10	7C x 2.5 sqmm armoured control cable	Meter	9000.0
3.11	12C x 2.5 sqmm armoured control cable	Meter	10000.0
4	**Junction box/Push Button station**		
4.1	Junction boxes (FRP) upto 48 way	No	58.0
4.2	Junction boxes above 48 way	No	20.0
4.3	Junction boxes for TSS Drivers, FRP	No	14.0
4.4	Void		

4.5	MTM FRP JUNCTION BOX-24 WAY WITH CANOPY	No	5.0
4.6	Start/Stop Push Button Station	No	70.0
5	**Panels/Cubicles/Racks/Enclosures/Monitors/Computer/Computer peripheral/PLCs/UPS/Batteries**		
5.1	Local Instrument racks (LIR)APPROX. SIZE IN MM: 2200(H) X 200+1400+150(W) X 650(D)	No	3.0
5.2	Computer Furniture (Approximate qty: Computer Table-05 nos, Printer Table-01 nos, Chairs-10 ns)	Set	1.0
5.3	TSI For Main Turbine including HMI & Printers Turbovisory System for Main Turbine along with new sensors, cables- Replace Turbovisory (vibration probes shaft and pedestal, speed probes, axial shift, expansion measurement, eccentricity measurement etc.) for main turbine with new sensors, cables etc.	Set	1.0
6	**Instruments/Devices including sensors/Cells/Probes etc**		
6.1	DP Transmitters	No	6.0
6.2	Pressure Transmitters	No	66.0
6.3	Pressure Gauge / DP Gauge/DP Indicator	No	86.0
6.4	Pressure Switch/ DP Switch/ DP Indicating Switch	No	16.0
6.5	Thermocouple / RTDs with thermowell (all types) along with converters wherever applicable	No	278.0
6.6	Temperature Gauge (all types)	No	21.0
6.7	Temperature Switch	No	3.0
6.8	Level Transmitter/GUIDED WAVE RADAR TYPE LT	No	9.0
6.9	Level Indicator	No	7.0
6.10	Level Switch Float Type/Conductivity Type	No	7.0
6.11	Position Transmitter	No	23.0
6.12	Load Transducer	No	3.0

6.13	Limit Switch/Heavy Duty Limit Switch	No	47.0
6.14	Solenoid Valves (3-way, AC/DC, 1/4", 1/2", 1", NPT/BSP, single/dual coil)	No	10.0
6.15	O2 (OXYGEN Aanalyzer) Along with accessories, caliberation unit, Gas Cylinders, JBs etc.	Set	4.0
6.16	CO AnalyzerAlong with CO transceiver unit, probe, TT, PT, Panel, Gas cylinders, JBs, Tubing etc.	Set	2.0
6.17	MTM T/C - 9.5MM OD ROUTE LENGTH 18M To 22M	No	14.0
6.18	Void		
6.19	SADC Power Cylinder	No	64.0
6.20	Burner Tilt Power Cyliner	No	8.0
6.21	MASS FLOW METER FOR HFO MAIN LINE	Set	3.0
6.22	BURNER TILT SHEAR PIN FAILURE INDI BOX	No	4.0
6.23	Speed Detector	No	9.0
7	**HMI**		
7.1	Operator Work Station along with accessories	No	4.0
7.2	Engineering Workstation (EWS)	No	2.0
7.3	MAX Storian Workstation (max HIST)	No	1.0
7.4	OPC workstation	No	1.0
7.5	A4 Multifunction Printer	No	1.0
8	**Flame Scanner**		
8.1	FLAME SCANNER HEAD ASSY.	No	20.0
9	**Conduits/Impulse pipe/tubes**		
9.1	Impulse Pipe ASTM A335, P22 Size:1/2" NB SCH 160	Meter	400.0
9.2	Impulse Pipe ASTM A106 Gr C Size:1/2" NB SCH 80	Meter	1400.0
9.3	Impulse Pipe A106 GR C 3/4" NB SCH 80	Meter	300.0

10	**Commissioning and Testing activities for equipments erected by other agencies like Control Valves, On/Off Valves, Electrical/Pneumatic Valves, Actuators, Solenoid Valves, Valves, Limit Switches, ERV Controllers, Power Cylinders, Pressure and Temperature Gauges, Transmitters etc.**		
10.1	Wall Blower, LRSB, Air Heater Soot Blowers	No	90.0
10.2	Electrical Actuators	No	100.0
10.3	Control Valves, electrically operated valves, Dampers and Gates, Miscellaneous Drives etc. (Regulating & ON/OFF Type)	No	130.0
10.4	Void		
10.5	Testing and Commissioning of 415V LT Motors including dry out	No	70.0
10.6	Limit Switches	No	50.0
10.7	Exhaust Fans	No	10.0
11	**Miscelleneous Structural Steel including Frames for Panels/Racks/Instruments/Supports for Cable Trays/Pipes/Tubes/Canopies etc.**		
11.1	Structural Steel for fabrication (MS angle, Channel, Plate etc)/ Cable Tray Structural steel fabrication and installation	MT	10.0
12	**Above Ground Earthing & Lightning Protection Materials**		
12.1	8 SWG GI Wire	Meter	500.0
12.2	65 X 8 MM GI FLAT	Meter	200.0
12.3	50 X 6 MM GI FLAT	Meter	400.0
12.4	25 X 6 MM GI FLAT	Meter	500.0
13	**Dismantling & Removal of items from site and handover to Customer's store**		
13.1	Dismantling/Disconnection/Reconnection of Existing Cables (Number of Cable Runs)	No	1000.0
13.2	Dismantling of structural steel	MT	5.0

14	**Civil works:Civil works like modification in cut out for panels, making approach through walls, breaking of concrete floors to suite DCS Panels, MCC/SWGR Panels erection, Battery Room modification, Electronic/Instrumentation Earth Pit etc. wherever required. (As per volume of work with cutting of concrete slab).**	**Lot**	**1.00**
15	**ELECTRICAL**		
15.1	Fire Sealing System	Lot	1.0
15.2	Testing and Commissioning of Electrical Hoist for Vacuum Pump Handling non-hazardous, Capacity 3.2T, Lift 7M, Travel Path Straight 10M	No	2.0
15.3	NUMERICAL RELAY COMMISSIONG CHARGES	SET	1.0
15.4	220V DC Battery Charging System with Battery (Approx: 2X170 Cells) with DC Battery Charger, DCDB etc. Approx. Total weight of Battery System: 23MT, approx. weight of battery charger: 2MT.	Set	2.0

SECTION-B ADDITIONAL WORKS

SECTION - B			
JOB Description: Additional Works			
16	**Lighting/Illumination System**		
16.1	Luminaire Type FC81 (LED) - Corrosion proof, totally enclosed type LED fixture having integral driver	Nos	75
16.2	20mm GI JB 3way circular Epoxy coated	Nos	50
16.3	20mm GI JB 4way circular Epoxy coated	Nos	50
16.4	20 mm Saddle with spacer(base) patti Or Saddle with base (20mm) for fixing light fixtures on wall	Nos	2000

16.5	Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories for system completeness and installation at site as per specifications and site requirement. (suitable for 415V/3-phase supply) as specified. Following fans shall have min. 20 mmwc static pressure. Capacity 6,000 CMH with Motor rating 1.1 KW	Nos	1
16.6	Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted) complete with casing, flame proof motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted for system completeness and installation at site as per specifications and site requirement (suitable for 415V/3-phase supply). Following fan shall have 15 mmwc static pressure. Capacity 15,000 CMH with Motor rating 2.2 KW	Nos	3
16.7	Wall mounted dampers (gravity operated) along with all accessories for complete installation at site as per specifications and site requirement. (500MMx500MM)	Nos	1
16.8	Inlet Louvres along with all accessories for complete installation at site as per specifications and site requirement. (1300MMx1300MM)	Nos	3
16.9	Wash Basin with Tap and drain	Nos	1
16.10	Eye Washer	Nos	1
16.11	Lighting Panel 12 Way AC	Nos	1
16.12	1/2“ SS Tube	Mtr	500
16.13	¼” SS Tube	Mtr	2500

SCHEDULE OF ITEMS QUANITTIES AND FACTOR FOR DEPRIVING ITEM RATE FROM THE ACCEPTED LUMPSUM PRICE.

This Chapter consists of Part A & Part B of Volume II "Price bid":

CONTENTS	
Description	**Remarks**
Part A: Instructions to the Bidders	Instructions
PART B: % weightage for amount of individual items of Schedule of quantity	Refer Latest Chapter-XI: Schedule of items Quantities and Factor for deriving Item Rate from the accepted Lump sum Price

Part A: Instructions to the Bidders

1. **Bidders shall quote Total Lump-sum Price for the entire scope of work in Rupees in VOL II PRICE BID at BHEL E-procurement Portal.** Any other entry elsewhere in the offer of the bidder shall be treated as Null and Void. The total value including value of St No. A shall be automatically calculated on E-portal
2. This Quoted Lump-sum Price shall be distributed based on the BHEL fixed percentage weightages w.r.t the total Total Lump-sum Price quoted by the bidder for the subject tender.
3. BHEL has pre-fixed the Weightage/Factor as detailed above in this chapter for deriving the Item Rates. By multiplying BHEL pre-fixed the Weightages / Factor and the total prices derived in sl no. 2 above; item rate of individual items shall be derived. Item Rate/Item Rate thus arrived shall be rounded off to two decimal places.
4. Item Rates derived in Sl. no. 4 shall be divided by quantity of respective items to derive Unite Rates. Unit Rates thus derived shall be rounded off to two decimal places
5. **Grand Total amount for the work shall be derived by BHEL by summing up respective total amounts.**
6. **Bidders to note that this is an item rate contract. Payment shall be made for the actual quantities of work executed at the unit rate arrived at as per Sl No.4 above.**
7. For the convenience of bidders, BHEL has issued an excel sheet with all the requisite formulae as described above. ***However, the referred excel sheet shall not form part of contract document. Further, this sheet should not be uploaded at the e-Portal.***

PART B: % weightage for amount of individual items of Schedule of quantity w.r.t. the total price (as quoted by the bidder in part C of Vol-II-Price Bid Specification)

Sr. No.	Description of Items	UOM	Qty	Factor
1	**Cable Tray and Accessories- Complete with Coupler Plates, Fasteners, Clamps and Fixing Hardwares etc. Erection including Support and Covers**			
1.1	Galvanised Ladder Type Cable Tray, W=600mm	Meter	100	0.002550191
1.2	Galvanised Ladder Type Cable Tray, W=300mm	Meter	150	0.003248270
1.3	Galvanised Ladder Type Cable Tray, W=150mm	Meter	150	0.002731818
1.4	Void			
1.5	Perforated cable tray and accessories (with or without cover) 300mm	Meter	150	0.003648536
1.6	Perforated cable tray and accessories (with or without cover) 150mm	Meter	500	0.010221915
1.7	Perforated cable tray and accessories (with or without cover) 100mm	Meter	200	0.003254587
1.8	Perforated cable tray and accessories (with or without cover) 50mm	Meter	600	0.008831800
2	**Instrumentation Cables**			
2.1	Screened Copper Cable 2P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	3000	0.007276059
2.2	Screened Copper Cable 4P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	15000	0.040294368
2.3	Screened Copper Cable 8P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	5000	0.016741253
2.4	Screened Copper Cable 12P x 0.5 sqmm armoured / unarmoured, G-Type or F-Type	Meter	2000	0.008372000
2.5	Screened Cable 4P x 1.5 sqmm armoured / unarmoured	Meter	2000	0.004941348
2.6	Thermocouple Cable: 2PX0.5 sqmm,Kx Type ''K'' Type Extension Cable unarmoured/armoured	Meter	6500	0.012649328

2.7	Co-Axial Cable for IRIG-B Signal Communication for master clock system	Meter	1000	0.004893280
2.8	Flame Scanner Cable- P/O Shielded	Meter	1000	0.003230142
2.9	Network UTP Cables in flexible GI pipes (special termination using UTP connectors involved)	Meter	600	0.002935968
3	**Power Cables**			
3.1	1CX630, Al, XLPE, PVC-FRLS, Arm, 1100 V	Meter	1600	0.010101334
3.2	1C-400 ARMOURED	Meter	600	0.006541861
3.3	2CX95 sq.mm, Cu, XLPE, PVC-FRLS, Arm	Meter	220	0.001107944
3.4	2CX2.5 sq.mm, Cu, XLPE, PVC-FRLS, Arm	Meter	3000	0.006645687
3.5	3CX95 sq.mm, Al, XLPE, PVC-FRLS, Arm	Meter	100	0.000720464
3.6	3CX25 sq.mm, Al, XLPE, PVC-FRLS, Arm	Meter	400	0.002004006
3.7	3C-16 ARMOURED	Meter	600	0.002293236
3.8	3C x 2.5 sqmm armoured control cable	Meter	12000	0.029648085
3.9	5CX2.5 sq.mm,Cu, PVC-FRLS, U/A, 1100 V/Armoured Cable	Meter	3500	0.012362982
3.10	7C x 2.5 sqmm armoured control cable	Meter	9000	0.028453263
3.11	12C x 2.5 sqmm armoured control cable	Meter	10000	0.039278082
4	**Junction box/Push Button station**			
4.1	Junction boxes (FRP) upto 48 way	No	58	0.012035609
4.2	Junction boxes above 48 way	No	20	0.005297267
4.3	Junction boxeS for TSS Drivers, FRP	No	14	0.002905147
4.4	Void			
4.5	MTM FRP JUNCTION BOX-24 WAY WITH CANOPY	No	5	0.002210305
4.6	Start/Stop Push Button Station	No	70	0.009401635
5	**Panels/Cubicles/Racks/Enclosures/Monitors/Computer/Computer peripheral/PLCs/UPS/Batteries**			

5.1	Local Instrument racks (LIR) APPROX. SIZE IN MM: 2200(H) X 200+1400+150(W) X 650(D)	No	3	0.003460709
5.2	Computer Furniture (Approximate qty: Computer Table-05 nos, Printer Table-01 nos, Chairs-10 ns)	Set	1	0.005742872
5.3	TSI For Main Turbine including HMI & Printers Turbovisory System for Main Turbine along with new sensors, cables- Replace Turbovisory (vibration probes shaft and pedestal, speed probes, axial shift, expansion measurement, eccentricity measurement etc.) for main turbine with new sensors, cables etc.	Set	1	0.011809405
6	**Instruments/Devices including sensors/Cells/Probes etc**			
6.1	DP Transmitters	No	6	0.002266768
6.2	Pressure Transmitters	No	66	0.024934452
6.3	Pressure Gauge / DP Gauge/DP Indicator	No	86	0.008946987
6.4	Pressure Switch/ DP Switch/ DP Indicating Switch	No	16	0.001896181
6.5	Thermocouple / RTDs with thermowell (all types) along with converters wherever applicable	No	278	0.035839380
6.6	Temperature Gauge (all types)	No	21	0.002482739
6.7	Temperature Switch	No	3	0.000337142
6.8	Level Transmitter/GUIDED WAVE RADAR TYPE LT	No	9	0.004039362
6.9	Level Indicator	No	7	0.002225769
6.10	Level Switch Float Type/Conductivity Type	No	7	0.002771692
6.11	Position Transmitter	No	23	0.004184334
6.12	Load Transducer	No	3	0.001582893
6.13	Limit Switch/Heavy Duty Limit Switch	No	47	0.001950121
6.14	Solenoid Valves (3 way, AC/DC, 1/4", 1/2", 1", NPT/BSP, single/dual coil)	No	10	0.000652991
6.15	O2 (OXYGEN Aanalyzer) Along with accessories, caliberation unit, Gas Cylinders, JBs etc.	Set	4	0.008138550

6.16	CO Analyzer Along with CO transceiver unit, probe, TT, PT, Panel, Gas cylinders, JBs, Tubing etc.	Set	2	0.020872274
6.17	MTM T/C - 9.5MM OD ROUTE LENGTH 18M To 22M	No	14	0.005253172
6.18	Void			
6.19	SADC Power Cylinder	No	64	0.040084695
6.20	Burner Tilt Power Cyliner	No	8	0.005010587
6.21	MASS FLOW METER FOR HFO MAIN LINE	Set	3	0.001100255
6.22	BURNER TILT SHEAR PIN FAILURE INDI BOX	No	4	0.001665193
6.23	Speed Detector	No	9	0.002253160
7	**HMI**			
7.1	Operator Work Station along with accessories	No	4	0.003308868
7.2	Engineering Workstation (EWS)	No	2	0.001654434
7.3	MAX Storian Workstation (max HIST)	No	1	0.000827217
7.4	OPC workstation	No	1	0.000827217
7.5	A4 Multifunction Printer	No	1	0.000454879
8	**Flame Scanner**			
8.1	FLAME SCANNER HEAD ASSY.	No	20	0.005132162
9	**Conduits/Impulse pipe/tubes**			
9.1	Impulse Pipe ASTM A335, P22 Size:1/2" NB SCH 160	Meter	400	0.017970135
9.2	Impulse Pipe ASTM A106 Gr C Size:1/2" NB SCH 80	Meter	1400	0.052305221
9.3	Impulse Pipe A106 GR C 3/4" NB SCH 80	Meter	300	0.012188840

10	**Commissioning and Testing activities for equipment erected by other agencies like Control Valves, On/Off Valves, Electrical/Pneumatic Valves, Actuators, Solenoid Valves, Valves, Limit Switches, ERV Controllers, Power Cylinders, Pressure and Temperature Gauges, Transmitters etc.**			
10.1	Wall Blower, LRSB, Air Heater Soot Blowers	No	90	0.007461009
10.2	Electrical Actuators	No	100	0.025848686
10.3	Control Valves, Electrically operated valves, Dampers and Gates, Miscellaneous Drives etc. (Regulating & ON/OFF Type)	No	130	0.038178653
10.4	Void			
10.5	Testing and Commissioning of 415V LT Motors including dryout	No	70	0.021276731
10.6	Limit Switches	No	50	0.002238439
10.7	Exhaust Fans	No	10	0.003039533
11	**Miscellaneous Structural Steel including Frames for Panels/Racks/Instruments/Supports for Cable Trays/Pipes/Tubes/Canopies etc.**			
11.1	Structural Steel for fabrication (MS angle, Channel, Plate etc)/ Cable Tray Structural steel fabrication and installation	MT	10	0.040784616
12	**Above Ground Earthing & Lightning Protection Materials**			
12.1	8 SWG GI Wire	Meter	500	0.000556897
12.2	65 X 8 MM GI FLAT	Meter	200	0.005187179
12.3	50 X 6 MM GI FLAT	Meter	400	0.007386477
12.4	25 X 6 MM GI FLAT	Meter	500	0.007779395
13	**Dismantling & Removal of items from site and handover to Customer's store**			

13.1	Dismantling/Disconnection/Reconnection of Existing Cables (Number of Cable Runs)	No	1000	0.026391850
13.2	Dismantling of structural steel	MT	5	0.006736816
14	**Civil works:** **Civil works like modification in cut out for panels, making approach through walls, breaking of concrete floors to suite DCS Panels, MCC/SWGR Panels erection, Battery Room modification, Electronic/Instrumentation Earth Pit etc. wherever required.** **(As per volume of work with cutting of concrete slab).**	Lot	1	0.026391288
15	**ELECTRICAL**			
15.1	Fire Sealing System	Lot	1	0.017594191
15.2	Testing and Commissioning of Electrical Hoist for Vauum Pump Handling non-hazardous, Capacity 3.2T, Lift 7M, Travel Path Straight 10M	No	2	0.001211372
15.3	NUMERICAL RELAY COMMISSIONG CHARGES	SET	1	0.008797096
15.4	220V DC Battery Charging System with Battery (Approx: 2X170 Cells) with DC Battery Charger, DCDB etc. Approx. Total weight of Battery System: 23MT, approx. weight of battery charger: 2MT.	Set	2	0.069714440
	SECTION-B/ ADDITIONAL WORKS			
16	**Lighting/Illumination System**			
16.1	Luminaire Type FC81 (LED) - Corrosion proof, totally enclosed type LED fixture having integral driver	Nos	75	0.005950011
16.2	20mm GI JB 3way circular Epoxy coated	Nos	50	0.006417366
16.3	20mm GI JB 4way circular Epoxy coated	Nos	50	0.006417366

16.4	20 mm Saddle with spacer(base) patti Or Saddle with base (20mm) for fixing light fixtures on wall	Nos	2000	0.004430458
16.5	Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories for system completeness and installation at site as per specifications and site requirement. (suitable for 415V/3-phase supply) as specified. Following fans shall have min. 20 mmwc static pressure. Capacity 6,000 CMH with Motor rating 1.1 KW	Nos	1	0.001716699
16.6	Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted) complete with casing, flame proof motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted for system completeness and installation at site as per specifications and site requirement (suitable for 415V/3-phase supply). Following fan shall have 15 mmwc static pressure. Capacity 15,000 CMH with Motor rating 2.2 KW	Nos	3	0.004738090
16.7	Wall mounted dampers (gravity operated) along with all accessories for complete installation at site as per specifications and site requirement. (500MMx500MM)	Nos	1	0.000137336
16.8	Inlet Louvres along with all accessories for complete installation at site as per specifications and site requirement. (1300MMx1300MM)	Nos	3	0.000412008
16.9	Wash Basin with Tap and drain	Nos	1	0.000137336
16.10	Eye Washer	Nos	1	0.000137336
16.11	Lighting Panel 12 Way AC	Nos	1	0.000436039
16.12	1/2 " SS Tube	Mtr	500	0.008582810
16.13	¼" SS Tube	Mtr	2500	0.042914052