VOLUME - IA

Technical Conditions of Contract (TCC) for “Electrical, C&I” Works

FOR

IOCL Paradip-Standby SRU (525TPD) Train project

BHARAT HEAVY ELECTRICALS LIMITED

	Technical Conditions Of Contract (TCC) **PROJECT ENGINEERING & SYSTEMS DIVISION** **HYDERABAD**	Ref No: HY/PE&SD/Projects/TCC/2020-21/Elec, C&I/01 Rev. No. 00

TECHNICAL CONDITIONS OF CONTRACT (TCC)

FOR

"ELECTRICAL, C&I" WORKS
FOR

IOCL PARADIP-STANDBY SRU (525TPD) TRAIN PROJECT

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Volume IA
Part I
Contract specific details

Chapter I- Project Information

1. **Introduction:** Indian Oil Corporation Limited (IOCL), the owner/ customer is intending to install a Standby Sulphur Recovery Unit (SRU) train of 525 TPD along with Tail Gas Incinerator at Paradip Refinery, Odisha. IOCL has appointed Technip India Limited as Project Management Consultant (PMC) for the project. The work has been awarded to BHEL on LSTK basis.

2. Project Details

1	Customer	:	IOCL, Paradip, Odisha
2	Project Information	:	IOCL Paradip-Standby SRU (525TPD) Train project
3	Location	:	Paradip, Odisha
4	Address Detail	:	IOCL, Paradip, Jagatsinghpur District, Odisha, India
5	Nearest Railway Station	:	Paradip Railway Station
6	Road Approach	:	118KM from Bhubaneswar via Cuttack and NH 53
7	Nearest Air Port	:	Biju Patnaik Airport, Bhubaneswar, Odisha, 125KM
11	Ambient Air Temperature (Average)	:	a) Maximum : 39^0 C b) Minimum : 16^0 C
12	Average Relative Humidity	:	71 %
13	Climatic Condition	:	Tropical Climate

Bidder is advised to visit the project site and appraise himself about the local conditions and infrastructure available in the area for fulfilling their commitments under the contract. BHEL will not admit any claims whatsoever on account of Contractor's non-familiarization of local conditions.

Chapter II- Scope of Work

The scope of the work will comprise of but not limited to the following: The scope of work under this specification covers, receipt of materials from BHEL/ Customer stores (maintaining DBR)/ storage yard, handling at stores/ storage yard, transportation to site of work, preassembly, erection, calibration, testing, pre-commissioning tests and checks, commissioning, trial run of various auxiliaries and equipment, achieving various milestones till handing over of the following electrical systems and associated items to BHEL's Customer:

1.0 Scope of Electrical work during plant shutdown period covered in this tender are as follows:

1.1 Modification of panels in 6.6kV Switchgear
1.2 LT Switchgear Extension
1.3 LT Switchgear Modification
1.4 LT Power Cable Work: Installation, testing, commissioning including termination, cable dressing, cable tagging, supply of all accessories (Cable glands, lugs, cable tags, markers, clamps, ties etc.) required for this work.
1.5 Installation, testing, commissioning of prefabricated cable trays, tray covers including erection hardware and painting wherever applicable.
1.6 Installation, testing, commissioning of plant earthing and plant lightning protection materials including erection hardware and painting wherever applicable.
1.7 Installation, testing, commissioning of UPS system along with UPSDB for FDA system.

2.0 Scope of Electrical work during post plant shutdown period covered in this tender are as follows:

2.1 Installation, testing, commissioning of 6.6kV HT XLPE Aluminum conductor armored cables.
2.2 LT Power Cable Work: Installation, testing, commissioning including termination, cable dressing, cable tagging, supply of all accessories (Lugs up to and including size 2.5 Sqmm, cable tags, markers, clamps, ties etc.) required for this work.
2.3 Installation, testing, commissioning of HT cable terminating kits.
2.4 Control cabling: Installation, testing, commissioning including all terminations, supply of all accessories (Lugs up to and including size 2.5 Sqmm, cable tags, markers, clamps, ties etc.) required for this work.
2.5 Installation, testing, commissioning of prefabricated cable trays, tray covers (GI & FRP) and cable ducts (GI & FRP) etc. including erection hardware and painting wherever applicable.
2.6 Installation, testing, commissioning of plant earthing and plant lightning protection materials including erection hardware and painting wherever applicable.
2.7 Installation, testing, commissioning of plant illumination package.
2.8 Installation, testing, commissioning of CCTV system.
2.9 Installation, testing, commissioning of local control station.
2.10 Installation, testing, commissioning of plant communication system (PA system & telephone).

2.11 Fabrication, erection of structural steel required for installation of equipment and systems

2.12 Installation of fire proof sealing materials, insulation mats

2.13 Supply, installation, testing and commissioning of chequered plates, erection hardware, cable accessories including glands, lugs, tags, markers etc., safety items like danger boards, Do not switch on boards, Man on work boards, display charts, first aid boxes near LT & HT panels, shock hazard charts, safety hand gloves, exit Signs, GI conduits, RCC Hume pipes, PVC conduits etc.

Chapter III- Facilities in the scope of BHEL/Contractor

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.1	**ESTABLISHMENT**			
3.1.1	**FOR CONSTRUCTION PURPOSE**:			
a	Open space for office (as per availability)	Yes		
b	Open space for storage (as per availability)		Yes	
c	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
d	Bidder's all office equipment, office / store / canteen consumables		Yes	
e	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
f	Firefighting equipment like buckets, extinguishers etc.		Yes	
g	Fencing of storage area, office, canteen etc. of the bidder		Yes	
3.1.2	**FOR LIVING PURPOSES OF THE BIDDER**			
a	Open space for labor colony (as per availability)		Yes	
b	Labor Colony with internal roads, sanitation, complying with statutory requirements		Yes	
3.2.0	**ELECTRICITY**			
3.2.1	Electricity For construction purposes		Yes	Electricity shall be provided by IOCL/ BHEL at one point on chargeable basis. Further distribution from IOCL/ BHEL feeder point shall be done by contractor. No separate payment for downstream power distribution shall be made. Contractor shall install a calibrated energy meter at feeder point for billing purpose.

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.2.2	Electricity for the office, stores, canteen etc. of the bidder		Yes	
3.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc.		Yes	
3.3.0	**WATER SUPPLY**			
3.3.1	For construction purposes		Yes	Water shall be provided by IOCL at one point on chargeable basis. Further distribution shall be done by contractor.–Further distribution from IOCL supply point shall be done by contractor. No separate payment for downstream water distribution shall be made**.**
3.3.2	Water supply for bidder's office, stores, canteen etc.		Yes	
3.3.3	Water supply for Living Purpose		Yes	
3.4.0	**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 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	
3.5.0	**COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER**			

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
a	Téléphone, fax, internet, intranet, e-mail etc.		Yes	
3.6.0	**COMPRESSED AIR wherever required for the work**		Yes	
3.7.0	**Demobilization of all the above facilities**		Yes	
3.8.0	**TRANSPORTATION**			
a	For site personnel of the bidder		Yes	
b	For bidder's equipment and consumables (T&P, Consumables etc.)		Yes	

3.9 Construction power will be provided to the contractor at one points within plant area by BHEL on chargeable basis at the applicable rate of IOCL. Feeder Rates are as follows:

Cat No	Load Demand	Feeder Rating	Cost/ Month (Rs.)
1	Up to 32A	415V, 32A	25000
2	>32A to 63A	415V, 63A	50000
3	>63A to 125A	415V, 125A	100000
4	>125A to 250A	415V, 250A	200000

3.9.1 In the event of power requirement (and or availability of power) is for less than one month pro- rata cost will be arrived on the basis of above rates. The required digital Energy meter for measuring the consumption and MD shall be provided and installed by the contractor. Any dispute regarding consumption, the BHEL engineer's decision is final. The contractor shall make his own arrangement for further distribution (as required within plant boundary and outside plant boundary) with necessary isolator / LCB etc.

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

3.9.3 The required energy meter for measuring power consumption shall be arranged by the contractor and taken care by the contractor. Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.

3.9.4 Contractor has to make their own arrangements for electricity requirement for labour colony at their cost. Any duty, deposit involved in getting the Electricity for contractors use i.e. Office shed, labour colony etc. shall be borne by the bidder.

3.9.5 BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.

3.10 Construction Water: Subject to availability, Construction water shall be provided by IOCL on chargeable basis. The cost of water supply shall be recovered from CONTRACTOR'S running/ final account bill at 0.25%.

However, in case BHEL/ IOCL is not able to provide construction water due to any reason whatsoever, CONTRACTOR shall be responsible for making all arrangements for Construction water at his cost. Any statutory requirements/ documentation etc. to this effect shall be met by the CONTRACTOR.

Non-availability of water due to any reason shall not entitle the CONTRACTOR for any claim against BHEL on account of cost and time implications.

Sl. No	**Description** **PART II** **3.9.0 CONSTRUCTION FACILITIES**	**Scope / to be taken care by**		*Remarks*
		BHEL	**Bidder**	
3.9.1	**Engineering works for construction:**			
a	Providing the construction drawings for all the works covered under this scope	**Yes**		Drawing schedule shall be finalized at the time of kick off meeting
b	Drawings for construction methods			NA
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	In consultation with BHEL
e	Preparation of construction (Concreting B/W, etc.) schedules and other input requirements		Yes	In consultation with BHEL
f	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments	Yes	Yes	In consultation with BHEL
g	Weekly construction schedules based on S. No. e. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
h	Daily construction / work plan based on S. No. g. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
i	Periodic visit of 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	Arranging the materials required for Work		Yes	
k	Coordination for inspection & checking and getting clearance from customer		Yes	
l	Preparation of formats for completion of activities		Yes	

Sl. No	Description PART II 3.9.0 CONSTRUCTION FACILITIES	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.10	**Work Permits, gate pass etc. from customer for manpower, machinery and material**		Yes	
3.11	Ambulance Services		Yes	BHEL will provide a common ambulance (inside plant)at site round the clock for medical emergency arising out of injuries (first aid and if required transporting the injured personnel to the nearest hospital) during execution of the works for all the workmen and staff of all the contractors including BHEL staff.

Chapter IV- Tools & plants to be deployed by Contractor

LIST OF TOOLS AND PLANT:

The following tools and equipment but not limited to, are required for the efficient execution of the electrical and civil works. The contractor shall make them available for construction purposes, including all consumables likely to be used at his own cost at the time of mobilization.

S.No.	Description	Minimum Quantity	Remarks
A. For Works			
1	Hydra	1	Need based
2	JCB	1	Need based
3	Tractor	1	Need based
4	Cable unwinding Machines, rollers etc	1 No	Need based
5	MC4 connector tool kit containing (1) crimping plier MC4, (2) open end spanner set MC4, (3) stripping plier MC4, (4) socket wrench insert to tighten, (5) socket wrench insert to secure, inserts for both 4 sq-mm and 6-sqmm (of both pliers).	2 Set	Need based
6	Electrical measuring Instruments		Need based
	a) Megger-1KV	1No	
	b) HV Tester-10KV	1No	
	d) Logic probe	1No	
	e) Modbus communication check kits	1No	
	f) Digital Multi meter	5 No	
7	Tong Testers	3 No	Need based
8	Digital power meters	1 No	Need based
9	Phase sequence meter	1 No	Need based
10	OFC termination kit, Splicing kits	1 Set	Need based
11	Primary /secondary injection kit	1 No each	Need based
12	~~Transformer oil filtration unit~~	~~1 No~~	~~Need based~~
13	Earth resistance measurement kit	1 No	Need based
14	Lugs, glands as in scope of supply	1 set	Need based
15	Transmission line stringing equipment	1 No	Need based
16	DG Sets	1 No	Need based
17	Cable jointing kit and associated tools	2 Set	Need based
18	Welding equipment	1 No	Need based
19	Flood lights	5 No	Need based
20	Set of screw drivers	1 Set	Need based

21	Set of Allen keys (mm & inch)	1 Set	Need based
22	Small size hacksaw & fraksaw	1 Set	Need based
23	Cutting pliers	2 No	Need based
24	Nose pliers	2 No	Need based
25	Insulation stripers	2 No	Need based
26	Dry cable jointer	1 No	Need based
27	Number punches	1 No	Need based
28	Alphabet punch	1 No	Need based
29	Embossing machine with cassettes (Numbers and alphabets)	1 No	Need based
30	Portable drilling machine up to 1-1/2"	1 Set	Need based
31	Soldering gun	1 No	Need based
32	Soldering Iron	1 No	Need based
33	Continuity tester	5 No	Need based
34	Double ended spanner Set of sizes 10-11, 12-13, 14-15, 16-17, 17-18	2 Nos each	Need based
35	Screwdriver Set	1 Set	Need based
36	Crimping tool with Dye range 50-400sq-mm cable, mechanical gear power, hand operated	1 Set	Need based
37	Crimping tool up to 6 sq-mm cable	1 set	Need based
38	Drilling machine AC, hand operated, with bit size up to 20 mm	1 set	Need based
39	Measuring Tape, 5m	2 Nos	Need based
40	Measuring Tape, 50 m	2 Nos	Need based
41	Allen Key set	1 Set	Need based
42	Adjustable spanner 2-inch size	1 No	Need based
43	Hammer	2 Nos	Need based
44	Rough file kit	1 Set	Need based
45	Cutting Pliers	2 Nos	Need based
46	Nose Pliers	2 Nos	Need based
47	Vacuum cleaner, of industrial type, for control room sweeping / cleaning.	1 No	Need based
48	Blowers for cleaning the panels	2 Nos	Need based
B. For civil works			
1	Digital Concrete Mixer 2 to 4 cum with hopper/Self-loading mobile concrete mixer (Azax)with printer	2 nos.	Need based
2	Needle Vibrator (Needle type 40mm)	4 nos.	Need based
3	Needle Vibrator (Needle type 25mm)	2 nos.	Need based
4	Dewatering Pump	2 nos.	Need based
5	Earth Compactor	2 nos.	Need based
6	Theodolite with staff	2 nos.	Need based

7	Dumpy level with staff	1 no.	Need based
8	Chain pulley block for lifting of panels		As required

1. BHEL will not provide any tool, plants, facilities or any testing facility/apparatus for the work. It will be contractor's responsibility to arrange all required tools, plants and other testing apparatus, etc. at their own cost. The prices quoted & finalized are inclusive of the charges towards providing such T&P. No extra payment will be entertained because of this.
2. All the tools and tackles brought for E&C works shall have valid calibration/ fitness certificate.

Chapter V- Time Schedule

5.1 TIME SCHEDULE

5.1.1
The entire work of "Electrical, C&I Works" as detailed elsewhere in the Tender Specification shall be completed within **Eighteen (18) Months** from the date of commencement of work at site.

5.1.2
During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

5.1.3
The work shall be commenced on the mutually agreed date between the bidder and BHEL engineer. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

5.2 COMMENCEMENT OF CONTRACT PERIOD

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

5.3 MOBILISATION

5.3.1
The activities for this work shall be started as per directions of Construction manager of BHEL.
5.3.2
The contractor should mobilize man power in order to complete the work in **Eighteen (18) Months**.
5.3.3
Requisite Material, men and machinery should be arranged in order to complete the project within stipulated time.
5.3.4
The contractor has to augment his resources in such a manner that following major milestones of the project are achieved on specified schedules:

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

5.4 CONTRACT PERIOD

For the purpose of contract, the period shall be taken as **Eighteen (18) Months**. Completion of the work shall be as per BHEL Bar Charts revised from time to time. In order to expedite the work, the contractor has to deploy manpower as per site requirement without any extra cost to BHEL.

5.5 GUARANTEE PERIOD

The guarantee period of twelve months shall commence from the date of completion of all works as certified by the BHEL site engineer.

5.6 PROTECTION OF WORK

The contractor shall have total responsibility for protecting his works until it is taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned.

If disagreement, conflict, or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be rectified. The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

5.7 Establishment of Construction power supply arrangement shall be completed within 30 Days from the date of commencement of work.

5.7 Tentative Schedule

Sl No	Description	Start	End
1	Mobilization to site	Zero Date (D)	D + 15 Days
2	Shutdown Works	D + 16 Days	D + 90 Days
3	Post Shutdown Works	D +300 Days	D + 540 Days

Schedule given above is tentative and subjected to customer permissions and front availability.

5.8 Schedule for Shutdown period Works: Customer (IOCL) is planning to give shutdown from October 2021 mid-week to 31 December 2021 tentatively (2.5 Months). Contractor shall mobilize approximately 15 Days before the shutdown starts for preparatory works and complete the shutdown period scope of work within 2 Months.

In case, contractor is not able to complete the shutdown period scope of work within the shutdown period, contractor shall have to complete it during running plant condition by taking all precautionary and necessary required measures in line with IOCL approvals.

Post shutdown work may be started after seven to eight month tentatively after completion of above shutdown, subjected to availability of site readiness and material availability at site or as per instruction of BHEL site in-charge.

Chapter VI- Statutory Regulation

6.1 BUILDING & OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) ACT, 1996 (BOCW Act) AND RULES OF 1998 READ WITH BUILDING & OTHER CONSTRUCTION WORKERS CESS Act, 1996 & CESS RULES, 1998 and

INTER-STATE MIGRANT WORKMEN ACT, 1979 (IN CASE BIDDER ENGAGE MANPOWER FROM OTHER STATE)

In case any portion of work involves execution through building or construction workers and/or inter-state migrant workers, then compliance to the above titled Acts as applicable shall be ensured by the contractor and contractor shall obtain license and deposit the cess under the Act. In the circumstances, it may be ensured as under:-

It shall be the sole responsibility of the contractor in the capacity of employer to forthwith (within a period of 15 days from the award of work) apply for a license to the Competent Authority under the BOCW Act and/or ISMW Act as applicable and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of license / permission to BHEL within a period of one month from the date of award of contract.

It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under these acts and rules including that of payment / deposit of cess as per the applicability under above referred Acts within a period of one month from the receipt of payment.

It shall be the responsibility of the sub-contractor to furnish the receipts / challans towards deposit of the cess together with the number, name and other details of beneficiaries (building/Inter-state Migrant workmen) engaged by the sub-contractor during the preceding month.

It shall be the absolute responsibility of the sub-contractor to make payment of all statutory payments & compensations to its workers including that is provided under the Workmen's Compensation Act, 1923.

Chapter VII: HSE (Health, Safety, Environment) and PPE (personal Protective Equipment) Guidelines

1. Contractor shall follow all the HSE guidelines as mentioned chapter IX off SCC and IOCL (Annexure-III).
2. In case of any dispute/ contradiction, IOCL HSE rules and guidelines shall prevail.

Chapter VIII- Field quality control plan

1. Work shall be executed as per approved field quality control plan (FQCP). Indicative quality control plan of IOCL is attached as Annexure-IV. Contractor shall prepare, submit the field quality control plan in line with IOCL QCP.

Submitted FQCP shall be reviewed and approved by BHEL/IOCL/ TECHNIP.

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Part II
Technical Specification: Electrical Works

1.0 GENERAL:

CONTRACTOR SHALL ABIDE BY THE SAFETY/ SECURITY RULES AND REGULATIONS AS PER THE REQUIREMENT OF IOCL/BHEL. CONTRACTOR SHALL OBTAIN INFORMATION ABOUT ALL SAFETY/ SECURITY NORMS OF IOCL WELL IN ADVANCE. BHEL WILL NOT ADMIT ANY CLAIMS WHATSOEVER ON ACCOUNT OF CONTRACTOR'S NON-FAMILIARIZATION OF SITE SAFETY/ SECURITY REGULATIONS.

1.1 The intent of this 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.

1.2 The scope of work under this specification broadly covers the receipt of materials from BHEL/Customer stores/storage yard, handling at stores/storage yard, transportation to site of work, preassembly, erection, calibration, testing, pre-commissioning tests and checks, commissioning, trial run of various auxiliaries and equipment as defined in scope of work Chapter-2, Part-I of TCC document, Bill of Quantities , achieving various milestones till handing over of the electrical system and associated items to BHEL's Customer.

Unloading of materials and storage is by other contractor. The scope of work also covers temporary storing (if required) of contractor's own construction material, using the same in the work, survey, excavation, backfilling.

1.3 All works such as cleaning, leveling, aligning, trial assembly, dismantling of certain equipments/ components for checking and cleaning, surface preparation, fabrication as per general engineering practice and as per BHEL engineer's instructions at site, cutting, gouging, weld depositing, grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, lapping, fitting up etc., as may be applicable in such erection works and which are treated incidental to the erection works and necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work within the quoted rates.

1.4 The work covered under this specification is of highly sophisticated nature, requiring the best quality of workmanship for engineering and construction management. The Contractor should ensure proper planning and successful and timely completion of the work to meet the overall project schedule. The Contractor must deploy adequate quantity of tools and plants, modern/ latest

construction aids, equipments etc. He must also deploy adequate trained, qualified and experienced supervisory staff and skilled personnel.

1.5 The work shall be executed under the usual conditions not affecting refinery unit construction and in conjunction with numerous other operations at site. The Contractor and his personnel shall cooperate with personnel of BHEL, BHEL's Customer, Customer's Consultant and other Contractors, coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work of the project as a whole.

1.6 Contractor shall carry out all work as per the sequence, instructions and methodology prescribed by BHEL depending upon the technical requirements. The sequence of activities, methodology will be decided by BHEL engineers depending upon the availability of material, drawings, work fronts etc. 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 grounds of deviation from the methods and sequence of construction advised by BHEL engineer or for any reasons whatsoever.

1.7 The contractor shall take delivery of the equipments from the BHEL stores/ storage area after getting the approval of BHEL engineer on standard indent forms of BHEL. Complete and detailed account of the materials and equipment's after usage shall be submitted to the BHEL and reconciled periodically.

Contractor shall plan and transport equipments, components from storage to erection site and erect them in such a manner and sequence that material accumulation at site does not lead to congestion at site of work. The contractor should also note that the transport of equipments to erection site, assembly yards etc. should be done by the prescribed route without disturbing the other works and contractors and in the most professional manner. Materials shall be stacked neatly, preserved and stored in the contractor's shed and at work areas in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work areas/ site to enable other agencies to carry out their work or for any other reason, contractor shall do it most expeditiously. No claim for extra payment for such work will be entertained.

Special equipments such as measuring and control equipments, panels, electronic items etc. shall be stored when taken over by the contractor in appropriate manner as per BHEL's instructions.

1.8 The Erection Contractor shall at his cost perform any services, tests etc. although not specified but nevertheless required for completion of the work.

1.9 All necessary certificates and licenses required to carry out this work are to be arranged by the Contractor expeditiously at his cost in time to ensure smooth progress of work.

1.10 The work shall conform to dimensions and tolerances specified in various drawings, documents etc. that will be provided during the course of construction. If any portion of the work is found to be defective in workmanship or not conforming to drawings or other stipulations due to Contractor's fault, 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 by BHEL at the cost and risk of the contractor.

BHEL reserves right to recover from the contractor any loss, which arises out of undue delay/ discrepancy/ shortage/ damage or any other causes due to contractor's lapse during any stage of work. Any loss to BHEL due to contractor's lapse shall have to be made good by the contractor.

1.11 The terminal points as decided by BHEL shall be final and binding on the Contractor for deciding the scope of work and affecting payment for the work done.

1.12 During the course of execution of this work, certain rework/ modification/ rectification/ repairs/ fabrication/ dismantling etc. will be necessary on account of feedback from Customer or BHEL/ revision in drawing 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 signed by BHEL engineer and indicating the details of work carried out, man-hours etc. shall be maintained by the Contractor for such reworks. Claims of contractor, if any, for such works will be dealt as per relevant clauses of General Conditions of Contract.

1.13 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.

1.14 All transport equipment, handling equipment, tools, tackles, fixtures, equipment, materials, manpower, supervisors/ engineers, consumables etc. except otherwise specified as in BHEL scope of free issue, required for the scope of this 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 clauses. The Erection Contractor's quoted rates should be inclusive of all such contingencies.

1.15 The Contractor shall make all fixtures, temporary supports, steel structures required for jigs and 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.

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

1.16 For any class of work for which no specifications have been laid down in these specifications, work shall be executed as per the instructions of BHEL.

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

1.18 The Contractor shall have total responsibility for all equipment and materials in his custody, including those loose, semi-assembled, assembled or erected by the Contractor at site and shall preserve these. 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. Overhauling, cleaning, servicing of equipments during erection and commissioning stages will be arranged by the contractor.

1.19 The contractor shall make adequate security arrangements including employment of security personnel and ensure protection of all materials/ equipments in their custody and the installed equipments from theft, fire, pilferage and any other damages and losses. Special care shall be taken to guard against pilferage/ theft of steel, cables/ conductors, brass fittings.

1.20 Contractor shall ensure proper housekeeping and remove all scrap materials periodically from various work area covered in the scope and deposit the same at the place earmarked for this purpose. In case of contractor's failure to do the same, BHEL reserves the right to remove scrap at contractor's cost and risk.

1.21 The weight and dimension as mentioned against the individual items in Price Bid/ Rate Schedules or elsewhere in the tender specification are indicative approximate and there may be variation in dimension and weight in actual supply of equipment. No rate variation shall be considered on this account.

1.22 The entire surplus, unused materials, damaged materials, packaging materials/ containers, special transporting frames, gunny bags, etc. shall be returned to BHEL stores by the contractor.

1.23 Contractor will be required to maintain in his site office at least one PC along with minimum accessories like printer etc. to enable him to carry out site activities in a planned, well-coordinated and smooth manner.

1.24 Access to site for inspection by BHEL and Customer engineers shall be made available by the Contractor at all times. The Contractor shall carry out the rectification pointed out without any extra cost to BHEL/ Customer. No cost whatsoever due to such duplication of inspection of work shall be entertained.

1.25 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" drawing. These drawings shall be endorsed by site engineer and handed over to BHEL.

1.26 Indicative Field Quality Plans are attached with the NIT.

The Contractor shall carry the work as per the Field Quality Plans issued by BHEL/ Customer.

1.27 Calibration of equipments should be done by NABL/ NPL accredited laboratories.

1.28 Welding procedure shall be followed as per Field Quality plan. Welding procedure and prequalification of welder are required to be produced, if required.

2.0 SUPPLY, ERECTION, INSTALLATION & COMMISSIONING (I&C) FOR ELECTRICAL WORKS:

2.1 Erection Contractor scope includes:

- The scope of work under this specification broadly covers the receipt of materials from BHEL/Customer stores/storage yard, handling at stores/storage yard, transportation to site of work, preassembly, erection, calibration, testing, pre-commissioning tests and checks, commissioning, trial run of various auxiliaries and equipment as defined in scope of work Chapter-2, Part-I of TCC document, Bill of Quantities.
- Supply, installation/Erection, unloading/ safe storage of Erection Contractor supplied items.
- Coordination / liaison activities (related to clearance / approval) with concerned state / central authorities such as CEIG/CEA etc, including renewal of CEIG license every year as applicable.
- Pre commissioning, Start up, performance test run, trouble-free operation and successful commissioning of the SRU plant.

2.2 Detailed Specification:

Erection Contractor scope – breakup of supply, E&C:

The table below indicates the scope of work for the Erection Contractor, as briefly outlined.

a)	**Supply**
1	Items as per Annexure-II
b)	**E: Erection, T: Testing, I: Installation and C: Commissioning:**
1	E&C: 6.6kV HT Switchboard after necessary Modification in 2 Feeders
2	E&C: 415V LT Switchboards Extension of Panels and necessary Modification
3	T&C: 110V UPSDB & 230V UPS DB and 220V DCDB Switchboards and other electrical panels Erection and Commissioning Works

4	I&C: Laying of cables for LT power cables, HT (6.6kV) cables, data communication / control / PMS/ OFC cables in RCC cable Trench/ overhead Cable Trays/ducts, Cable glanding and termination through lugs/Cable kits
5	E&C: Preparation/ Fabrication of cable support structures & Erection and Installation of cable supports and cable trays
6	E&C: Erection and commissioning of Earthing system
7	E&C: Erection and commissioning of lightning protection system
8	E&C: Erection and commissioning of illumination system
12	E&C: Erection and commissioning of LCS,PDBs/JBs
13	E&C: Erection and commissioning of PA System
14	E&C: Erection and commissioning of IP based telephone system
15	E&C: Erection and commissioning of CCTV System
16	E&C: Erection and commissioning of UPS for FDA System and it's accessories
17	I&C: Installation of fire proof sealing materials
18	T&C : Testing & Commissioning of Motors (HT/LT),MOVs/ Actuators
19	E&C: Erection and commissioning of miscellaneous electrical activities and safety items
20	T&C: Pre-commissioning inspections / checks / site tests
21	Coordination with state / central departments / CEA/ CEIG etc. for necessary approvals / clearances for commissioning
22	Handing over of mandatory spare/any other spares and special tools to customer
23	Post-commissioning operation of the plant

Note: In case of any contradiction between BHEL Specification and Customer Job Specification/ Installation Details, most stringent clause will be taken into consideration. Erection Contractor shall quote accordingly.

3.0 TECHNICAL SPECIFICATION FOR DESIGN, SUPPLY, ERECTION AND COMMISSIONING:

3.1 HT Switchgear:

Design & Supply: The existing 6.6 kV Motor feeders (Panel No. 33 & 64) at existing 6.6kV Switchboard (331S-SG-301) shall be used to feed the proposed Incinerator motors. HT Switchgear OEM shall do necessary Modification in the HT Switchgear Motor Feeders.

The above feeders are to be interfaced with existing PMS system for Control, Monitoring & load Shedding and with existing DCS system through IRP. Necessary configuration shall be done at existing PMS & DCS systems for the above interface as per contract. PMS System OEM shall do the necessary interface for PMS System interface.

Required assistance is to be extended by Erection contractor for HT Switchboard OEM for HT Switchgear modification works, PMS System OEM for PMS interface works.

For DCS System interface, erection contractor shall do the necessary cabling works as per cable schedules provided by BHEL during detailed engineering.

In addition to above, Erection Contractor shall consider the following:

1. Transportation & Storage of HT Switchgear components at intended location (if required).
2. Arranging labour/ worker/ electrician personnel (if required) to HT Switchgear Service Engineer, PMS System Service engineer during testing of HT Switchgear panels after installation of components & required modification done in the panels.
3. HT Cable Termination works in the panels after laying of HT cables.
4. Testing & Commissioning of HT Switchgear panels after installation of HT Drives in the field.
5. Coordination of customer & Drive vendors during testing & Commissioning of HT Switchgear panels & HT Drives in the field.

Testing:

For testing of HT Switchboard after modification, please refer Cl. No. 9.1 of Job specification for electrical installation, testing, Pre Commissioning and commissioning (Doc No: 080557C-000-JSD-1600-003, Rev No. A) for further details & tests applicable to HT Switchboard.

3.2 LT Switchgear Extension Panels:

Design & Supply: LT Switchboard Extension Panels as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Erection Contractor shall organize necessary resources such as labour/ worker/ electrician, cranes, hydra, forklifts, transportation trucks/ trolleys and other accessories for movement and positioning of the panels at the required location.

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.

Switchgear panels are normally supplied in suit of either one/two/three or loose shipping sections with integral base frame or loose supplied.

Panels shall be moved to the respective positions and installed over the cutouts in Switchgear/ Substation room, in the exact sequence and locations as per approved drawings to suit layout and foundation arrangements.

Dragging of the panels directly on floor is not allowed. Roller bars must be used for shifting of panels. Use of crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchboard panels shall be lifted after ensuring the panel supports, nut and bolts are all intact. While lifting the panels in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment.

Installation of panels shall include fixing of base frame, fabrication of base frame if required, leveling, 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. In certain case where canopies are not supplied but have to be fabricated out of MS sheets provided by BHEL, payment will be done on square meter basis.

Panels shall be suitably grouted using welding/ bolting methods as appropriate. BHEL approval shall be obtained for the grouting arrangement. All necessary hardware for the same shall be within Contractor's scope of supply.

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.

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.

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.

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.

Minor civil works like drilling, chipping, punching holes and opening in concrete floors, slabs and brick walls, grouting, related to Rack, support installation, minor civil works required for installation of control panels, Junction boxes etc., shall be included in the erection cost of such items. Also all miscellaneous 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.

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.

Testing:

After completion of installation of switchboards, all the cubicles, switchboard components such as switches, starters, CT and PT chambers, bus bar chamber shall be cleaned and checked for tightness of all the components.

All the wiring connections shall also be checked. Contact resistance of all bus bar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with Carbon Tetra Chloride (CTC) where required.

All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise free movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.

Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required, shall be done as per the directions of Engineer- in-charge. Special attention shall be paid to CT circuit's polarity, wiring continuity and correctness in the protection as well as measurement circuits. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Engineer-in-charge. The same shall be replaced.

Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire switchboard shall be dried- up according to the instruction of the Engineer-in-charge for the IR value to improve to a safe level for

commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.

All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Engineer-in-charge. Protection relays shall be inserted and connected and settings adjusted as required by the Engineer- in- charge.

All moving parts, of closing/tripping mechanism, racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up, cleaned and contact pressure measured.

All the control wiring, PTs, bushings, bus bars, other live parts of switchgear, incoming and outgoing cables shall be meggered.

Electrical simulation tests shall be carried out for all the protective, alarm and annunciation relays and external interfaces to ascertain proper functioning.

Pre-Commissioning Checks:

Before commissioning any switchboard, following points shall be checked and ensured for safe energizing of the switchboard:

a) That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to make the enclosure vermin proof.

b) That all the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.

c) That the polarity test and ratio test of all the PTs and CTs is complete and phase sequence of CTs conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits is correct.

d) That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.

e) That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault annunciations, data logging, and display of switchboard SLDs shall be verified from HMI in case the same is provided.

f) That IR Value has been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been

recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

g) Following tests shall be ensured for all CTs

- Insulation resistance test
- Ratio test through primary injection
- Polarity test
- Knee point voltage for class PS CTs

j) Following tests shall be ensured for all meters

- Calibration of meters
- Functional verification and settings

k) Following tests shall be ensured for all relays

- Secondary injection test
- Relay settings
- Timing check with timers
- Any other test recommended by the supplier

l) Following tests shall be ensured for all bus bars

- Tightness of all nuts/bolts using Torque wrench
- IR value
- Contact resistance
- Cleaning of bus bar chamber using vacuum cleaner
- Conducting jelly shall be applied on Al/Cu joints as per manufacturer's recommendations
- HV test in case of HV switchboard.

m) Following tests/Checks shall also be performed on the switchboards

- Functional verification of individual feeders including all spare feeders
- Simulation test for under voltage tripping of related feeders such as motor feeder, capacitor feeders etc.
- Verification of control supply schemes
- Stability test for all differential protections
- Checks for all panel illuminations, indicating lamps, sockets

- All upstream and downstream interlocks

3.3 110V UPSDB & 230V UPS DB and 220V DCDB Switchboards:

- **110V UPS DB in SR-111:**

6 Feeders need to be added in existing UPS DB in SR-811 (Addition of 2 nos. of 63A power feeder & 1 no. of 100A power feeder in each bus section; Total number of bus sections – 2 Nos.). Make of UPS DB is M/s Emerson. Contractor shall execute the above job through M/s Emerson only.

- **Testing & Commissioning of Existing Feeders in UPSDB & DCDB:**
- 2 No. of existing feeders in 331S-INST-UPS-001.
- 2 No. of existing feeders in 331S-INST-UPS-002.
- 2 No. of existing feeders in 220V DCDB.

3.4 UPS for FDAS:

Design & Supply: UPS for FDAS as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

The installation and commissioning of the UPS System shall be in Contractor's scope.

1. HDP Tubular or Ni-Cd (or similar type) or Lead acid 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. 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.

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

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

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.

Testing:

The Contractor shall also carry out the site tests on equipments/systems as specified below. However, these shall not be limited to this specification only and in case any other site test is required to be conducted as a standard practice of the Contractor or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer, the same shall also be carried out.

Functional Test

On completion of installation and commissioning of the equipment the following tests/checks shall be carried out with the max. available load, which does not exceed the rated continuous load. These tests/checks shall include but not limited to the tests as indicated below.

The details of the tests are as indicated below:

1. Light Load Test

This test is carried out to verify that the UPS is correctly connected and all functions operate properly. The load applied is limited to some percent of rated value. The following points should be checked:

(a) Output voltage, frequency and the correct operation of meters;

(b) Operation of all control switches and other means to put units into operation.

(c) Functioning of protective and warning devices.

(d) Operation of remote signaling and remote control devices.

2. Checking of Auxiliary Devices

The functioning of auxiliary devices, such as lighting, cooling, pumps, fans, annunciation, etc., should be checked, if convenient, in conjunction with the preliminary light load test.

3. Synchronization Test

If possible, frequency variation limits should be tested by use of a variable frequency generator, otherwise, by simulation of control circuit conditions. If applicable the rate of change of frequency during synchronization shall be measured.

4. AC Input Failure Test

The test is performed with a fully charged battery and is carried out by tripping input circuit breakers or may be simulated by switching off all UPS rectifiers and bypass feeder as at the same time. Output voltage variations are to be checked for specified limits with an oscilloscope or equivalent. Frequency variation is defined as the steady state frequency of the UPS with and without AC input. The rate of change of frequency is measured by the time it takes to reach steady-state values.

5. AC Input Return Test

AC input return test is performed by closing AC input circuit breakers, or is simulated by energizing rectifiers and bypass feeders.

Proper operation of rectifier starting and voltage and frequency variations are to be observed.

Note: This test is normally performed with a fully of or partially charged battery.

6. Simulation of Parallel Redundant UPS Fault

This test is applicable for UPS with parallel redundant connections. Faults of rectifier or inverter units may be carried out by simulation. Output transients are to be observed.

7. Transfer Test

This test is applicable for UPS with bypass, particularly in the case of an electronic bypass switch. Transients shall be measured during load transfer to bypass caused by a simulated fault and load retransfer after clearing of the fault.

8. Full load test

Load tests are performed by connecting the actual load to UPS output.

Large UPS in parallel connection may be load tested by testing the individual UPS units separately. Load tests are necessary for testing output voltage and frequency, rated stored energy, recharge time, ventilation, temperature rise and determination of efficiency. Load tests are performed to prove transient voltage deviations specified under step load conditions.

9. Rated Stored Energy Time (Battery Test)

This test is a load test to prove the actual possible time of battery operation.

If rated load is not available in the case of large UPS, it is possible to apply a partial load to check the actual battery discharge characteristics and compare these with characteristics specified by the battery manufacturer. Discharge time with rated load shall then be calculated. The test shall be performed with a fully charged battery and also may be done under other battery conditions to be specified, if so agreed. Active power output of the UPS and the battery voltage shall be recorded during the test.

Since new batteries often do not provide full capacity during a starting up period, the discharge test may be repeated after a reasonable recharge time if the original test has failed.

10. Earth Fault Test

If the DC Power Supply/ UPS output is isolated from earth, then an earth fault can be applied to any output terminal. DC Power Supply/ UPS output transients (if any) shall be measured.

If the battery is isolated from earth, then an earth fault can be applied to any output terminals. DC Power Supply/ UPS output transient (if any) shall be measured.

The arrangement of Load bank for Load tests is in Erection Agency scope.

3.5 Cables Trays, Cable Ducts and Accessories:

Cable Tray & Cable Trench works comprises of following major Activities:

Scope for construction of RCC cable trench, sand filling & supply of red brick is in BHEL/civil contractor scope & same is excluded from scope of this enquiry.

1) Erection & installation of Cable Tray Support structure and Cable trays in SS-331S.

2) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts in SRU area.

3) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts in SRR-811.

4) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts from SRR-811 to MCR.

4) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts in Outdoor area as per Drawings mentioned in Annexure-1 (List of Drawings).

Design & Supply: Various types of GI/ FRP Cable Trays, FRP Cable Ducts and Accessories like hardware(bolts, nuts and washers), bends, reducers, coupler plates, tray covers, tray clamps etc. as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

(1) Erection Contractor shall install cable trays, fittings and accessories as per approved Notes and Details for Cabling System. Typical Power Installation Standards for Construction (Drg No: 080557C-000-STC-1692-001) are enclosed for reference. Approved Notes & details for cabling system shall be provided to the erection contractor after award of contract/during execution.

(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 cable tray/duct layout.

(3) Erection Contractor shall place and fit these cables trays over the steel support structure (angles, sections etc.). Steel supports shall be installed at every 1.5 meter for horizontal cable trays and at every 1 meter for vertical cable trays.

(4) Suitable cutouts, wherever applicable, shall be made in the cable trays to provide path for the cable to reach the lower level trays.

(5) Adjacent cable trays shall be interconnected using suitable hardware items.

(6) Installation of tray/duct covers, wherever provided, will be done as a part of tray erection and no extra rates will be payable.

(7) Cable trays shall be earthed as per approved Notes and Details for Earthing System.

(8) In certain cases, it may be necessary to site fabricate portions of trays, supports and other non-standard bends where the normal prefabricated trays, supports and accessories may not be suitable. 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 meter). Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminum paint.

(9) Cable trays/ ducts have to be routed underground in cable trench, over head on structure, along walls, floors, structure etc. for various applications.

(10) Welding of cable trays to structural steel is not allowed. All cable trays shall be bolted to the structural supports. Bolts, nuts & washers for installation is in BHEL Scope of Supply & same shall supplied along with Cable trays.

Wherever supplied, GI cable trays/Ducts/FRP cable Trays/FRP cable Ducts shall be of bolted construction only with fixing screws and coupler plates.

Sharp bends of cable trays shall be avoided in all type of cable trays.

Steel embedment shall be provided in the cable trenches, ceiling slabs and concrete blocks for installing the cable racks and support structures.

3.6 HT/ LT/ Control/ Communication Cables:

Design & Supply: Various types of LT power cables, HT (6.6kV) cables, data communication / control /signal/ PMS/ OFC cables/Armoured/Unarmoured cable as per BoM specified elsewhere will be supplied by BHEL.

Erection Contractor Scope of Supply: Copper tinned lugs of various types (pin, ring, fork etc.,) upto 4 sq.mm (as required in case of any contingency), PVC cable ties, PVC ferrules, PVC tapes, cable identification tag of Stainless steel, clamping and dressing material with hardware, PVC sleeves, sealants 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.

Erection & Commissioning:

Cable laying includes cutting to the required length, laying in overhead/underground cable trench/RCC Sand filled 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/aluminium lugs, insulated/un-insulated, termination (crimp, soldering, etc.), plug-in connections with insert type crimping, providing identification tags of Stainless Steel (at both the ends and at 30 m intervals throughout the route length and also at each bend).

Note: - 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 done.

Cable Routing, Laying, Dressing:

Erection Contractor shall perform cable laying, dressing and termination as per approved Notes and Details for Cabling System. Typical Power Installation Standards for Construction (Drg No: 080557C-000-STC-1692-001) are enclosed for reference. Approved Notes & details for cabling system shall be provided to the erection contractor after award of contract/during execution.

Cable installation shall be carried out as per IS: 1255 and other applicable standards.

The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case, shall drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables.

For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable

drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.

Cable schedules indicating cable sizes and tentative routes will be furnished by BHEL at site to the contractor. Required steel inserts(if any) in substation building & SRR-811 will be provided by BHEL.

All the cables (HT, LT, communication, control etc.) shall be properly laid, in line with cable schedules, on cable trays in separate tiers with appropriate spacing.

Many of the cable trays and cables have to be laid in existing 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.

Contractor shall carefully plan the cutting schedule of each cable drum in consultation with site engineer such that wastages are minimized. Recovery will be made in case the wastages are exceeding the wastage allowances fixed in this contract.

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

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.

Cables entering into rooms from outside shall be bunched appropriately. The multiple bunches shall be routed through conduit pipes (PVC/Hume pipes etc.) of appropriate type, diameter and length that shall be fixed below the plinth level.

When cables pass through floors, walls etc., it shall be passed through a pipe for mechanical protection and the pipe ends sealed suitably.

While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

Where cable passes through brickwork or concrete work, the contractor shall provide suitable local protection against mechanical damage wherever necessary.

Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/HDPE pipe.

Wherever few cables are branching out from main trunk route troughs shall be used.

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.

In each cable run, some extra length shall be kept at suitable point to enable one LT/ two HT straight through joints to be made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

No cable shall be laid in ducts or trenches where other services such as oil pipes, steam or water pipes are laid.

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.

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.

No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted.

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.

Directly Buried Cables:

Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS: 1255.

RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

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/Inst cables	2
4.	Impulse pipe/tubes/GI pipes/copper tube	1

If however, the Erection Contractor 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 is more than the specified figure, then equivalent price of the excess portion will be deducted from the contractor's bill.

Cables shall be dressed using appropriate cable ties at appropriate intervals to ensure firmness of their position over the trays.

Trefoil clamps shall be used wherever single core cables are used for three-phase system. These clamps shall be fixed at appropriate intervals to ensure firmness of bunching of cables.

All necessary resources such as labour/worker/electrician, tools and accessories required carrying out laying and termination works etc. shall be within scope of Contractor.

Conduits/Pipes/Ducts Installation:

a) The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made waterproof by the Contractor.

b) GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

c) Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.

d) Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit / Pipe Size (Dia.)	Spacing
Upto 40 mm	1 m
50 mm	2.0 m
65-85 mm	2.5 m
100 mm and above	3.0 m

e) For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

Cable Terminations & Connections:

The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2 mm thick aluminium sheets/rubber grommets/dummy plugs.

Control cable cores/pairs entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self-locking type nylon cable ties with de interlocking facility to keep them in position.

All the cores/pairs of the control cable to be terminated shall have identification by providing ferrules at either end of the core. Each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, etc. along with cable numbers and coiled up after end sealing.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections.

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.

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. Spare holes of JB/Panels are to be sealed as per the requirement.

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.

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.

3.7 Cable Markers and Cables Tags:

Design & Supply and Erection & Commissioning:

Cable markers and joint markers for underground cables shall be supplied and installed along the route of the cables as per section "Typical Power Installation standard for construction (Doc No: 080557C001-000-STC-1692-001)" of this specification.

Cable tags shall be provided at either end of the cable (at the entry point to the panel/ equipment to which it is connected/ terminated) as per section "Typical Power Installation standard for construction (Doc No: 080557C001-000-STC-1692-001)" of this specification.

Erection Contractor shall submit the respective schemes of marking and tagging for BHEL approval during detailed engineering.

Testing:

All electrical connections shall be tested for polarity and proper connections.

The checking of operation of individual equipment and instruments to which the cabling/wiring connected shall also be done by the contractor.

Before energizing, the insulation resistance of every circuit shall be measured from phase to phase, phase to neutral and from phase/neutral to earth.

Where splices or terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before splicing and or terminating. After completion of splices and /or terminations measurements shall be repeated.

The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.

For cables, up to 1100V grade 1000 V Megger and for H.V. Cables 2.5 KV / 5 KV Megger shall be used.

DC High Voltage test or AC High Voltage test shall be conducted on cables given below after installation.

- All 1100-volt grade power cables in which straight through joints have been made.
- All cables above 1100 V grade.

The DC High Voltage test shall be performed as detailed below in the presence of the Engineer-in-charge or his authorized representative only.

Cables shall be installed in final position with the entire straight through joints complete. During the high voltage test, all other electrical equipment related to the cable installation, such as switches, instrument transformers, bus bars, etc., must be earthed and adequate clearance shall be maintained from other equipment and framework to prevent flash over. In each test, the metallic

sheath/screen/armor shall be connected to earth.

3.8 Illumination System:

Design & Supply: Illumination System materials as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Installation of illumination fixtures, panels, junction boxes, cabling etc. shall be in the scope of Contractor. Erection shall be carried out as per approved Notes and Details for Plant Illumination System.

Testing:

The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 5 mega ohms. (Between phases, phases to neutral, phase/neutral to Earth).

- Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If required load shall be balanced on the three phases.
- The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
- After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
- It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
- Operation of ELCBs shall be checked.

3.9 Lightning Protection System:

Design & Supply:

Lightning Protection materials as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

a. Erection and Commissioning of Lightning Protection system including erection of poles/masts, down conductors, all related accessories and hardware, earth connections, earth pits etc. for complete SRU shall be in Contractor's scope. However, construction of foundation/ earth pit shall be in BHEL scope. Earth pit back filling with salt and charcoal is in the scope of Contractor.

b. Erection shall be carried out by Contractor as per the approved Notes and Details for Earthing and Lightning Protection System and approved FQP that shall be provided to the successful Erection Contractor after award of contract.

Commissioning and handing over of Lightning Protection system is in Contractor's scope.

Testing:

In case lightning related earth pits are not connected to main earth grid, for lightning protection, the value of earth pit resistance shall be 5 ohms, but in no case, it shall be more than 10 ohms.

If lightning earth pits are connected to main earth grid, individual earth pit resistance

3.10 Earthing System:

Design & Supply:

Earthing materials as per BoM specified elsewhere will be supplied by BHEL.

Supply of following items is in the scope of Contractor:

- Back filling material for all the treated earth pits in plant area. Quantity of earth pits for back filling: 10 nos. approx.

Erection & Commissioning:

Excavation and laying of underground earth mat & provision of risers is in BHEL/Civil contractor scope.

Construction of Earthing pit as per drawing with charcoal & salt, GI pipes, GI earth electrodes, GI wire, GI strips, brick chamber with covers including associated earthwork is in BHEL/Civil contractor scope.

However, any additional earth pits required may be provided by contractor as per Cl. No. 8.9 & 8.10 of Erection BOM.

However, auxiliary earth mat with in SRU/SS-331 (if required) shall be provided by contractor. Any additional risers required as per site requirement shall also be in contractor scope.

Earthing of metallic frames of all electrical equipments, electrical panels, support steel structures, lightning arrestors, cable trays, steel columns, lighting poles, motors, equipments, metallic structures etc. as applicable to nearby riser/earth pit/auxiliary mat shall be by Contractor.

1. All joints in the earthing system shall be welded type. Earthing connections to all equipments including motors shall be bolted type.

2. Earthing connections shall be free from tinning scale paint, enamel, grease, rust or dirt at the time of making joint.

3. Metallic sheaths, screens/shields and armour of all multicore cables shall be bonded and earthed.

4. Earthing conductors along their run on columns, beams, walls etc. shall be supported by suitable cleats at intervals of 750 mm.

Welded joints on GI earthing conductors shall be painted. Refer clause no. 2.1.14 for details.

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.

If the equipment is not available at the time of earthing conductor laying tap connections from the main earthing conductor shall be brought out up to slab equipment foundation level with at least 200 mm spare length left for further connections to equipment earthing terminals.

Erection shall be carried out by Contractor as per the approved Notes and Details for Earthing and Lightning Protection System and approved FQP that shall be provided to the successful Erection Contractor after award of contract.

Water has to be poured by Contractor for first 15 days after installation and then once in six months.

Testing:

On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked.

Resistance of individual earth electrode shall be measured after disconnecting it from the grid by using standard Earth Test Megger / Resistance Tester.

Earthing resistance of the grid shall be measured after connecting all the earth electrodes to the grid.

The resistance to earth shall be measured typically at the following points:

- At each electrical system, neutral earth.
- At each earth provided for structure lightning protections.
- At points on earthing system used to earth electrical equipment enclosures.
- At points on earthing system used to earth wiring system such as metal conduits and cable sheaths or armour.
- At points on fence enclosing electrical equipment.

All equipment required for testing shall be furnished by contractor.

3.11 PA System:

Design & Supply: PA system equipment as per BoM specified elsewhere will be supplied by BHEL.

Erection:

PA system equipment like amplifiers including PA instruments like Field Call Station (FCS), loud speakers suitable for mounting in Zone-1 hazardous area, all hardware/software and associated cables within field, from field to SS-331S, within SS-331S shall be supplied by PA system vendor. The scope of vendor also includes supply of required equipment to interface with existing PA system and integrate with existing Neumann make PA system at site.

All the above PA system equipment as per BOM shall be issued to Erection contractor for erection & installation at intended locations.

The erection contractor shall include PA System erection works such as installation of PA System equipment in the intended locations including fabrication of base frames(if required) for installation, transportation of these base frames to the indented locations, providing man-power assistance to PA System vendor for smooth commissioning of PA System & other works as applicable for completeness of PA System.

Transportation assistance of the materials from BHEL stores to the intended locations, lifting facilities (cranes), supervision during erection, supervision during commissioning and other co-ordination are in scope of erection contractor.

Testing & Commissioning:

Testing & commissioning of PA system, supervision during erection of PA system equipment is in the scope of PA system vendor.

3.12 Telephone System:

Design & Supply: Telephone System equipments as per BoM specified elsewhere will be supplied by BHEL.

Erection:

Telephone System vendor shall supply telephone system equipment like cards / modules, MDF, IDF Field Exd telephones and associated telephone cabling within field, from field to SS-331S, within SS-331S. The scope of vendor also includes supply of required equipment to interface with existing system and integrate with existing AVAYA make Telephone system at site.

All the above Telephone system equipment as per BOM shall be issued to Erection contractor for erection & installation at intended locations.

The erection contractor shall include erection works such as installation of Telephone System equipment in the intended locations including fabrication of base frames(if required) for installation, transportation of these base frames to the indented locations, providing man-power assistance to Telephone System vendor for smooth commissioning of Telephone System & other works as applicable for completeness of telephone System.

Transportation assistance of the materials from BHEL stores to the intended locations, lifting facilities (cranes), supervision during erection, supervision during commissioning and other co-ordination are in scope of erection contractor.

Testing & Commissioning:

Testing & commissioning of Telephone system, supervision during erection of Telephone system equipment is in the scope of Telephone system vendor.

3.13 CCTV System

Design & Supply: CCTV System equipment as per BoM specified elsewhere will be supplied by BHEL.

Erection:

CCTV System vendor shall supply CCTV system equipment like LIU, converters, amplifiers including PTZ CCTV cameras suitable for mounting in Zone-1 hazardous area, all hardware/software and associated cabling within field, from field to SS-331S, within SS-331S. The scope of CCTV system also includes supply of required CCTV System equipment compatible to interface with existing system and to integrate with existing CCTV system at site.

All the above CCTV system equipment as per BOM shall be issued to Erection contractor for erection & installation at intended locations.

The erection contractor shall include erection works such as erection of CCTV Poles (if applicable), water connection installation for CCTV Camera, installation of CCTV System equipment in the intended locations including fabrication of base frames (if required) for installation, transportation of these base frames to the indented locations & providing man-power assistance to CCTV System vendor for smooth commissioning of CCTV System & other works as applicable for completeness of CCTV System.

Transportation assistance of the materials from BHEL stores to the intended locations, lifting facilities (cranes), supervision during erection, supervision during commissioning and other co-ordination are in scope of erection contractor.

Testing & Commissioning:

Testing & commissioning of CCTV system, supervision during erection of CCTV system equipment is in the scope of CCTV system vendor.

3.14 Insulating Mats:

Design & Supply:

Insulating Mats as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Laying of Insulating Mats in front of all indoor electrical panels (newly supplied in this project) viz. LT Switchgear extension panels, UPS panels etc.

3.15 Fire Proof Sealing Materials:

Design & Supply:

Fire Proof Sealing Materials as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

All entry and exit openings for cables passing through GI/ PVC conduits, cable trenches in substation, control room etc. shall be provided with fire barrier. Erection and commissioning shall be carried out strictly as per manufacturer recommendation.

All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using fireproof sealing material.

3.16 Chequered Plates:

Design & Supply and Erection & Commissioning:

Chequered Plates minimum 6 mm thick MS for closing the cable trenches, cutouts, and other open trench areas shall be supplied and installed by the Contractor.

The design of the Chequered Plates shall be such that the maximum allowable deflection is L/200 (where L is the span of the chequered plates in meters) for a live load of 500 kg/sq. meters.

Chequered Plate shall have suitable handle welded to the Plate to facilitate ease of lifting and movements. Width and length of the Plates shall be selected so as to neatly seal the required areas without any gaps. Additional stiffeners shall be provided at the bottom, if required. Plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation followed by black painting. BHEL approval shall be obtained for overall arrangement of the Chequered Plates.

3.17 Structural Steel for Supports:

Design & Supply:

Structural Steel as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Erection of above Structural support material is in the scope of the Contractor. This shall be used for fabrication of cable tray supports, panel base frame, JB supporting frames, LCS supporting frames etc.

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 the same shall be used for fabrication of Local Instrument Racks, panel base frame, cable tray supports, Canopies for instruments/panels/ drives/JB"s/Push Buttons etc., Instrument/Junction box frames, Impulse Pipe/Instrument Air Pipe supports and instruments etc.

2. This shall include cutting to size, contouring of ends for connections if required, welding, grinding of excess weld deposits/burrs, drilling of holes for mounting of device/instrument, installation at location, levelling, alignment, providing bracings and painting etc. No gas cut holes will be permitted.

3. All the fabricated supports/frames for instruments, trays, pipes, electrical equipment's, etc., shall be epoxy painted after sand blasting / shot blasting (as applicable) and surface preparation as per painting specifications. Paints and other associated items are in the scope of the contractor.

4. Frame 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/worker/electrician and meet all other requirements as part of work.

5. In case, structural cable trays, bends, tees, reducers etc., 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 instances.

6. In certain packages, members of frames/rack for mounting of junction boxes/ instruments may be supplied readymade. These have to be assembled prior to installation. The installation rate as quoted shall include assembly of the frames.

7. Gas cutting of tray/impulse pipe support and holes in frame is not permitted. Only hacksaw cutting/ drilled hole shall be permitted.

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

9. In this project, Welding is not allowed for cable tray support structures. Required SS nuts, bolts, washers shall be considered in contractor scope.

3.18 Junction Boxes (JB) and Local Control Stations (LCS)/Local Push Button Stations(LPBS):

Design & Supply:

JBs and LCS as per BoM specified elsewhere will be supplied by BHEL.

Hardware for erection (like Nuts, Bolts and Washers etc.) wherever required shall be in the scope of the Contractor.

Erection & Commissioning:

Erection & Commissioning of JBs and LCS is in the scope of the Contractor. The locations are to be jointly decided at site during erection. The JBs and LCS are to be erected on the frames fabricated at site.

Testing:

Checking of installation for correctness.

Functional checking/ adjustment of JB / PB for their system.

3.19 Display Boards and Sign Boards:

Design & Supply and Erection & Commissioning:

Supply and Installation of the following are in Contractor's scope:

Board displaying instruction chart for restoration of person from Electric Shock

Board displaying instruction chart for artificial respiration

Board displaying dos and don'ts

Danger boards with details such as value of voltage etc for string monitoring boxes, PCUs, LT panels, Transformers, HT panels, Four pole / two pole structures in switchyard etc.

3.20 Other Safety Related and Miscellaneous Items:

Design & Supply and Erection & Commissioning:

Following Safety Related Items and Miscellaneous Items shall be supplied by the Contractor. Make/ Part number of each item shall be submitted to BHEL for approval prior to procurement.

1	Round bottom fire buckets filled with clean dry sand.	Quantities shall be as per price bid
	Adequate number and size of CO2 fire extinguishers and dry chemical powder suitable for dealing with fire.	
2	Easily accessible first aid box containing ointments and medicines for treatment of electrical burns, conforming to IE rules.	
3	Framed laminated shock treatment chart, conforming to IE rules, in English and local language. Name, address and telephone number of nearest doctor shall be mentioned in it.	

4	Danger boards on switchboards and at other places as required by Engineer-in-charge.	
5	Caution notices for all energized electrical equipment.	
6	Instruction plate containing location of isolation point for incoming power supply, name and contact no. of the contact person in emergency	
	Self-contained portable hand lamp, complete with rechargeable battery.	
	Portable battery operated emergency light.	
	Artificial respiration system	
	Face shield	
	HV and MV insulated gloves	
	Framed single line diagram	

3.21 Pre-commissioning / commissioning and post commissioning activities:

- ✓ The work is also inclusive of various commissioning activities of SRU package along with its auxiliaries and station C&I package. 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.

- ✓ In case any malfunctioning and/or defects are found during tests, trial runs such as loose components, undue noise or vibration, strain on connected equipments 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.

- ✓ 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 governed by the GCC. The parts to be replaced shall however be provided by BHEL free of cost.

- ✓ The pre-commissioning activities will start prior to steam blowing activity and various trials, commissioning operations shall continue until the unit is handed over to customer.

Simultaneous commissioning activities will be in progress in various areas, checking of equipments erected, making ready for trial runs, alkali flushing, chemical cleaning, mass flushing etc. 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.

- ✓ 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.

- ✓ 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 if any, for such works from the contractor shall be governed by GCC.

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

- ✓ 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.

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 peak months there could be requirements of separate commissioning gangs simultaneously in even upto 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.

- ✓ 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.

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

- ✓ 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.

Calibration, Testing & Commissioning:

- ✓ Calibration, testing & commissioning activity as specified in this technical specification and rate schedule against various equipments, devices, systems etc. are broadly classified below. However, there may be some overlapping between the

activities (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.
- 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 equipments 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 equipments 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 upto recording/indicating instrument/HMI monitors.
- Adjustment, testing, calibration of pneumatic drive (control valve, trip valve, power cylinder for gate/dampers), electrical actuator operated valve/gate/dampers of other functional elements.
- Checking the interlock, protection and alarm for various processes 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/feed back 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., and 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 for Trial Operation 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 in Trial Operation for reasons attributable to the Contractor shall result in re-start of the Trial Operation 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 trial run.
- Contractor shall submit the as- built drawing as per guidelines and instruction of BHEL engineer.
- After trial run/handing over of the equipment, if due to unforeseen reasons, certain works crop up; the contractor shall provide all the assistance.

3.22 General conditions applicable during supply, installation and commissioning phase

1	As already mentioned in previous clauses, three-phase power supply will be made available by IOCL on chargeable basis at three points for construction purposes. Contractor has to make the required lines, power conversion, control and distribution network for meeting construction loads.
2	All machinery such as cranes, hydra, JCBs, forklifts, transport trucks, trolleys etc necessary for movement and installation of materials / panels / equipment etc shall be organized by the Erection Contractor.
4	All necessary tools and tackles such as crimping tool (including heavy duty tools for crimping copper/aluminium cables up to 300 sq-mm), screw driver set, power screw drivers, cutting pliers, nose pliers, spanner sets, adjustable spanners, hole saw cutter set, bending tools, torque wrenches, hack saw blades, pipe wrenches, flat / round files, HV termination tools, drilling machines, welding machines, concrete mixers, steel bar bending tools / templates for RCC works, spade, shovel, hammer etc. shall be organized by the Erection Contractor.

5	All necessary measuring instruments such as digital multimeters, electrical testers, digital meggers (1kV, 2.5kV, 5kV), lamp load testers, earth resistance meters, weighing machines, water level indicators etc. shall be organized by the Erection Contractor.
6	Erection Contractor shall maintain updated labour/worker/electrician register, with name, age, qualification, salary, attendance details etc. at the site.
7	Erection Contractor shall use danger boards, wherever required, to ensure safety of the persons during the work at site.
8	Erection Contractor shall adhere to all necessary safety norms such as use of helmet, goggles, hand gloves, gumboots, aprons etc. It is the ultimate responsibility of the Erection Contractor in all respect to prevent accidents at the site and safeguard their labour/worker/electrician from accidents.
9	Erection Contractor shall, at the completion of every work, clear off the debris, which resulted out of the work. In case of excavation work such as cable trench etc. Erection Contractor shall finish the land neatly with necessary leveling, rolling etc.
10	Erection Contractor shall carry out the work without causing inconvenience to other contract groups at the site. In case of conflicts with other groups, Erection Contractor shall ensure that the matter is resolved at once amicably so that the progress of work is not affected.
11	Any damages on the building, structures etc. attributable to the acts of labour/worker/electrician/ employees of Erection Contractor shall be rectified and made good by the Erection Contractor at their own cost.
12	Any miscellaneous materials, which are found essential for technical completion of the contract but not mentioned explicitly in this specification, shall be deemed to be included in the specification. Accordingly, such materials shall be included by the Erection Contractor as part of the offer.
13	For the items to be supplied by Erection Contractor, test certificates, as per relevant IS / IEC standards, as issued by manufacturer shall be submitted to BHEL. However, prior approval shall be obtained from BHEL/IOCL for procurement of these items.
14	Field Quality Plan / Quality control system Erection Contractor shall erect and commission the equipments/ items in accordance with FQP (Field quality control plan) as approved by BHEL/IOCL. Erection Contractor shall deploy a well-experienced quality control engineer to monitor all QC activities at site as per approved FQP.
15	Any deviations shall be discussed with BHEL / IOCL site engineers and implementation shall be taken up only after approval from BHEL / IOCL.
16	Erection Contractor shall submit periodic status report, on daily as well as weekly-consolidated basis, to BHEL on the progress of the contract.

4.0 DOCUMENT SUBMISSION:

4.1	**Documents to be submitted along with the offer**: ➢ Signed and stamped No deviations schedule ➢ Signed and stamped Un price schedule format ➢ Type test reports (as applicable)
4.2	**Documents to be submitted after award of Purchase order:** Following documents shall be submitted by Erection Contractor after the placement of order. ➢ MDL Master document list shall be submitted by Erection Contractor within 1 week after the award of contract to BHEL for approval. ➢ Design documents (GA, Calculations, layouts, Datasheets, erection drawings, schemes, BOM etc.) Refer to respective package section of this specification for the list of documents to be submitted by Erection Contractor to BHEL for approval. However, in addition to these documents wherever BHEL finds applicability, Erection Contractor shall carry out design and prepare additional documents for BHEL approval. ➢ Manufacturing Quality Plans for the Erection Contractor supplied items ➢ Field quality plan for the field work ➢ Detailed activity-time chart for project implementation. ➢ Detailed manpower deployment schedule. ➢ As built documents

HIERARCHY

In case of any conflict/deviations amongst various documents, the order of precedence shall be as follows:

- Statutory Regulations
- IOCL specification
- Items in Schedule of quantities
- IS/BS/IEC standards
- BHEL's standard specification (with prior approval of Engineer-in-charge).

NOTE: The above technical specification is not exhaustive. In case for any item of work, technical specification is not available, such items of works will be carried out in conformance to technical specification of manufacturer's recommendations/best engineering practice. In case of any dispute between two specifications or non-availability of specifications, customer's specification will prevail. Decision on applicability of any particular specifications will rest with BHEL engineer and his decision in the matter will be final & binding on the contractor. Contractor has to make himself well conversant with the Customer specification.

Annexure-I

LIST OF DRAWINGS

S. No	Title
1.	Plot Plan
2.	SS-331S Equipment Layout
3.	SRR-811 Equipment Layout
4.	SRU-3 Equipment Layout
5.	SS-331S Earthing Layout
6.	SS-331S Floor Cutout Drawings
7.	Outdoor area Cable Tray/Trench Layout
8.	SRU area Cable Tray/Trench layout
9.	SRR-811 area cable Tray layout
10.	Job Specification
10.1	Typical Earthing and Lighting Protection Installation Standards For Construction (Drg No: 080557C-000-STC-1691-001)
10.2	Typical Power Installation Standards for Construction (Drg No: 080557C-000-STC-1692-001)
10.3	Typical Lighting Installation Standards for Construction (Drg No: 080557C-000-STC-1693-001)
10.4	Job Specification for Electrical Installation, Testing, pre commissioning and Commissioning (Doc No: 080557C-000-JSD-1600-003)
10.5	Job specification for Site testing of electrical equipment & Installation (Doc No: 080557C-000-JSD-1600-103, Rev No. A)
11.	Soil investigation report
12.	Control Room layout
13.	B366-088-16-50-00010 Rev0_SLD

Annexure-II (ERECTION BOM)

Annexure-1 & Annexure-3 of Annexure-II: LIST OF ITEMS BEING SUPPLIED BY BHEL

Note: Quantities may vary between annexure-1, annexure-2 and price bid format. Similar items are considered as a single line item in price bid format. In such cases, quantities/ items of price bid format shall prevail.

Annexure-2 & Annexure-4 of Annexure-II: LIST OF ITEMS TO BE SUPPLIED BY CONTRACTOR

Note: Quantities may vary between annexure-3, annexure-4 and price bid format. Similar items are considered as a single line item in price bid format. In such cases, quantities/ items of price bid format shall prevail.

DEVIATION SCHEDULE (TECHNICAL)

Sl.No.	Cl. No./ Page No./Sec No.	Description as specified	Deviation taken	Remarks/ Reason for Deviation
fhg				

NOTES:

1. Erection Contractor may give a consolidated list of deviations in this form only. Only the deviations listed here in conjunction with the original tender, shall constitute the contract document for the award of the job to the Erection Contractor.
2. Deviation listed elsewhere shall be ignored & will be summarily rejected.
3. If there are no deviations, Erection Contractor shall submit signed copy of this format, mentioning "No Deviations" & it shall be henceforth implied that Erection Contractor is complying with all the clauses of the bidding document.
4. Attach more sheets in this format, if required.

(Signature of the Erection Contractor)

Volume IA
Part III
Technical Specification: C&I Works

1. Introduction

The document elaborates the details of Bill of Material for Instrumentation and control's scope of Balance of plant area for erection purpose.
The erection agency shall carry out the complete erection and commissioning of the system including material receipt at site, unloading and transfer to site, safe storage, unpacking, transport to site location, installation, testing, calibration, commissioning, minor defects, repair as possible, co-ordination with vendors/ customers, making as built documents, final testing to the client satisfaction and handing over to site in-charge/ client in safe and operational condition.

Note:
1. Quantity indicated below is preliminary based on basic engineering documents & it may vary during actual erection work.

2. General conditions for Erection agency

Following section provides the details of construction, erection, installation and commissioning work involved with respect to supplies to be made by BHEL HYD (PE&SD) for the above-referred project. Following activities will be part of the erection agency:

a. Erection/installation works
b. Commissioning/field testing
c. Site support inclusive of following works
d. Receipt of material at site from BHEL stores
e. Transportation to plant site
f. Loading & Handling of material at site inclusive of all necessary handling equipments
g. Covered storage facilities at site
h. Obtaining of necessary statutory approvals in line with the local regulations
i. Complete civil works required for the installation of electrical and instrumentation packages
j. Preparation of as built markup drawings for all equipments and packages
k. Supply of all necessary commissioning & installation tools/tackles & test equipment

The work detailed below is in addition to any other arrangement considered elsewhere and is to be followed as a minimum. The concerned E&C agency is to ensure that the below mentioned work is covered in their scope while identifying their overall scope of the above referred project.

2.1 C&I Supplies for EPC Package:

All loose C&I supplies like local instruments, cables, Flow meters, Hook up items, DCS / PLC Package, SWAS package, etc. are to be received FROM BHEL/ IOCL stores, stored and erected as per applicable engineering documentation. These supplies are generally supplied from various BHEL units or from different vendor works.

The supervision and administration of the packages vendor's work and human resources to ensure that the work is completed in time and as per approved documentation to be included in Site Erection & Commissioning agency scope. The site is to ensure that vendor's work progress and completion is facilitated by providing necessary administrative and logistics based support, as required.

S. No.	Equipment /Package Description	Qty (No's)	Weight (each) KGs	Remarks
[B]	**INSTRUMENTS**			
(1)	Flow Nozzle assemblies	10	35	
(2)	Flow Orifice Assemblies	12	20	
(3)	Flow venture assemblies	5	140	
(4)	Rota meters	35	7	
(5)	Rupture Disc	2	10	
(6)	Mass flow meter	2	20	
(7)	Ultra Sonic Flow meter	0	45	
(8)	RADAR Level Transmitter	15	7	
(9)	SMART transmitters (PT, DPT, FT, LT, TT)	160	5.4	
(10)	Hand Held Communicator	2	0.5	
(11)	Pressure Gauges	90	1.1	
(12)	Differential Pressure gauges	5	1.1	
(13)	Level Gauges	15	15	
(14)	Temperature Gauges with Thermowell	46	1.1	
(15)	Temperature Elements (Thermo Couple, RTD, Multipoint thermocoples)	45	1.2	
(16)	Thermowells	12	1.75	
(17)	FRP Canopies	500	5	
(18)	Remote Indicators	2	5	
(19)	Junction Boxes (WP & ExP)	180	12	
(20)	Instrumentation items for on skids/Packages and their other auxiliary packages	1 Lot	-	
(21)	Equipments & items supplied by ERECTION AGENCY contractors, if any	1 Lot	-	
(22)	MCT Blocks	1 Lot	-	

Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.

3. Scope of Instrumentation Package

Following table consists of typical **Bill of Quantity** instrumentation supplied by BHEL for **this tender**, which is to be erected and commissioned by Erection Agency. ERECTION AGENCY shall be responsible for erection & commissioning of all the equipments or items supplied by BHEL as per detail engineering and construction document, which deems to be part of this project & necessary for successful operation of the plant.

3.1 Instruments:

The BHEL shall supply following items/ instruments in loose condition from various vendors work to the project site. ERECTION AGENCY shall carry out erection & commissioning of these item/instruments as per Owner's approved drawing, input documents from BHEL.

3.2 Instrument Installation materials, pipes, tubes and fittings:

Following material shall be supply by BHEL/ Vendor in loose condition. Erection contractor shall fabricate and assemble the instrument impulse line connections at project site, as per provided design document.

S. No.	Equipment /Package Description	Qty (No's)	Weight (each) KGs	Remarks
[C]				
(1)	Tubes	4000 meters	0.2	
(2)	Female Connector	250	0.21	
(3)	Male Connector	382	0.24	
(4)	Air Manifolds	30	6	
(5)	Valves (ball)	235	0.5	
(6)	Manifolds	350	0.9	
(7)	Unions	360	0.23	
(8)	Caps	120	0.22	
(9)	Reducers	250	0.4	
(10)	Nipples	300	0.1	
(11)	TEE	220	0.35	
(12)	Elbow	210	0.33	
(13)	Plugs	105	0.2	
(14)	Coupling	230	0.26	
(15)	Syphon	20	0.55	
(16)	Condensate Chamber	25	1.2	
(17)	Pipes	2000	0.8	
(18)	Flanges	1 Lot	1.5	

(19)	Gaskets	1 Lot	0.03	
(20)	Stud 2 Nuts M20x90	1 Lot	0.3	
(21)	Cable Glands	1 Lot	0.35	
(22)	Cable Lugs	1 Lot	0.1	
(23)	Pre-fab hook-ups for PT	45	12	
(24)	Pre-fab hook-ups for FT	35	18	
Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.				

3.2 <u>Raw material shall be supplied by BHEL and to be fabricated, erected & commissioned by erection agency:</u>

a) BHEL HYD (PE&SD-C&I) shall supply the following raw material for various instrument supports,

b) C&I contractor shall fabricate the instrument supporting structures, stands. Contractor can use modified drawing as per site convenience, to meet the mounting location, elevation, space availability etc. in consultation with site- in charge

S. No.	Equipment /Package Description	Qty	Weight (each) KGs	Remarks
[D]	**RAW MATERIALs**			
(1)	2" pipe for transmitter and JB mounting & Support set up	1 Lot	2	
(2)	MS angle iron- 50x50x6 mm for panel base frame & its site fabrication	1 Lot	0.8	
(3)	MS Angle (75x75x6)	1 Lot	1.5	
(4)	Impulse line supporting clamps	1 Lot	-	
(5)	STR STL 6MM (1500x5000X6)	1 Lot	1	
(6)	ISMC MS CHANNEL (100x50)	1 Lot	6	
(7)	Nuts & Bolts, Clamps	1 Lot	0.3	
(8)	Nut , bolts, washers	1 Lot	0.2	
(9)	False flooring Base frame stand for panels	1 Lot	5	
(10)	Cable Fastening Material			By Erection Agency

Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.

4. Special Requirements

a. Instrument impulse lines are piping based with welded end connections. The pipe & pipe fitting shall be as per piping specification.
b. Painting of impulse line, instrument / JB supports etc shall be in erection agency scope. Painting procedure as per main piping/ Customer specification.
c. The supply of paint, primer, painting tools shall be in erection agency scope.
d. The entire site erected impulse lines are subject to hydro test, radiography test in line with approved field quality plan (FQP) requirements. It shall be in erection agency scope.
e. Mounting of Pre-fabricated canopies supplied by BHEL, shall be in the scope of erection agency.
f. Statutory approvals like IBR, local agencies etc as required shall be in erection agency scope.
g. Calibration of instruments before erection shall be carried out and relevant documents to be submitted to BHEL/IOCL by erection agency.
h. The all skid mounted impulse lines are subject to hydro test, radiography test in line with mother pipe requirements at site. Same shall be in erection agency scope
i. Calibration of skid mounted instruments before commissioning shall be carried out by erection agency.
j. Instrument Air line 1" up to 6 mm are SS.
k. Instrument cable support system from instrument to Junction box shall be fabricated at site by erection agency.

5. Packages to be Erected & Commissioned by ERECTION AGENCY

BHEL shall supply following instrument packages/ panels. Erection, installation and commissioning shall be in ERECTION AGENCY scope.
The scope of ERECTION AGENCY shall be as per scope matrix given in this document. Scope includes transportation from store to site location, placing in the location & alignment as per design documents, co-ordination with client/ OEM vendor, wiring, power on, testing, loop testing, functional testing, minor modifications as feasible, if required etc. as per OEM and BHEL design documents and handing over to customer in working condition.

S. No.	Equipment /Package Description	Qty	Dimension (each) LxBxH (M)	Weight (each) KGs	Remarks
1	**Process Gas analyzers & Gas Chromatograph**	1 Set	Panel - 2400X800X1200 [3 No's] (or) pre-fab Shelter of 4 x 5 meters	2 Tons	
2	**MCMS system**	1 Set	Panel - 2400X800X1200 [1 No's]	850 kgs	
2	**DCS + PLC SYSTEMs** consisting of (located at SRR-811 & MCR-815) • Operator consoles; Engg consoles; Printers • marshalling panels, & system panels • networking cables, Inter panel cables hardwired consoles etc	1 Set	Panel - 2400X800X1200 [30 No's] Work stations / HWC / printers / furniture's / etc. – 1 Lot	15 Tons	

	• Furniture • Cabling from field to panel in control room & to other panels.				

Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.

6. Instrumentation control & signal Cables

BHEL shall supply following cables rolled in wooden/steel drums. Erection & installation shall be in ERECTION AGENCY scope. Erection contractor's scope shall be to lay and terminate the cables at both the ends as per BHEL design documents.

S. No.	Equipment /Package Description	Quantity (meters)	Weight (each) KGs / meter	Remarks
[A]	**Instrumentation CABLEs**			
(1)	12P x 1.5 mm2	40000	1.52	
(2)	12P x 2.5 mm2	3600	1.86	
(3)	8T x 1.5 mm2	7000	1.97	
(4)	1P x 1.5 mm2	46000	0.39	
(5)	1P x 2.5 mm2	6000		
(6)	1T x 2.5 mm2	4000	0.63	
(7)	2P x 20 AWG	2000	0.43	
(8)	Field bus cables	30000	0.45	

Note:

1. The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.
2. Supply and installation of cable lugs, tags, cable-dressing material shall be in erection agency scope.
3. Cable glands at the both the equipment ends shall be supplied by BHEL/Vendor. In case of misplacement/ misuse of cable glands at site, erection agency shall supply and complete the respective cable installation.

7. Erection Specification for Instrumentation Work

1.0 GENERAL

1.1 This specification is applicable for Control and Instrumentation of BOP area only supplied by BHEL.
The intending bidder shall be deemed to have visited the site and familiarized themselves thoroughly with the site conditions before submitting their tender.

1.2 The work is generally complete one for design, manufacture and supply to site under supply contract and storage, erection testing and commissioning under erection contract. The Agency shall make his own arrangement for all material and shall furnish a list of all erection and handling equipment, he proposes to employ in the work. He will, provide and maintain at site all equipment, necessary to complete the work in time.

1.3 The bidder is expected to be fully familiar with the local regulations and statutory requirements and any rework, if insisted by the local authorities, the same will be carried out by the Agency at no extra cost.

1.4 It shall be the responsibility of the Agency to obtain necessary license/work permits from the licensing board of the locality/state/country.

2.0 Scope of Work

2.1 The Agency shall employ skilled technicians and shall be in a position to carry out the work as per the furnished drawings. The Agency at his own cost shall redo any work, which is not as per the drawings or does not conform to good workmanship, within the stipulated time. The Agency shall also arrange all materials required for redoing the work. The working personnel at site must be familiar with the relevant instrumentation standards.

2.2 The supply, Erection/Commissioning work shall be carried out in accordance with the specifications/drawings furnished. The layout drawing furnished is intended to give the bidder a general idea of the type and extent of work involved. Final drawings shall be issued to the successful bidders before the start of the work at site. All equipment, materials provided by the Agency shall conform to relevant project specified & international Standard.

2.3 The scope of work includes the following:

Complete assembly, erection, calibration, testing, commissioning and putting into successful and satisfactory commercial operation of the control and Instrumentation materials as given in Price bid format:

a) Installation of field instruments, control valves, safety valves etc. along with necessary impulse pipes and mounting materials as per the installation drawings.
b) Installation of Junction boxes along with supply of necessary angles/channels etc.
c) Installation and termination of cables and the supply of lugs, tag plates etc.
d) Installation of Transmitters along with necessary support/ bracket.
e) Field instruments such as transmitters, gauges, and switches shall be grouped and mounted on a rack. This rack along with the supply of angles and channels will have to be fabricated and painted at site by Agency as per the space available. The exact grouping and rack details will

be mutually worked out during the execution stage and the Agency will carry out the same at no additional cost implications.

f) BHEL/ Mechanical Erection agency will lay 2" Instrument air header. Further distribution starting from 2" air header upto the instrument/valve shall be done by the Agency with proper supports and fixture of the tube/fittings as per the hookup diagrams.
g) Branch trays of 50 mm or 100 mm size trays wherever required for laying one or two cables between the field instrument and the nearest Main tray will be erected by Agency (supply by ERECTION AGENCY).
h) The Agency will do complete loop-checking starting from primary field instrument up to the secondary instrument.
i) Laying of sample pipes from terminal point to sample handling system/Analyzers.
j) E&C of Control valve includes the erection and wiring/tubing of related I/P convertors, Solenoid valves, limit switches that may be supplied loose.
k) All site mounted/fabricated structures/impulse lines shall be painted after applying two coats of primer. The final paint shall be epoxy based and the shade shall be as approved by BHEL/IOCL.
l) Making the necessary excavations and back filling to the original level after the cables are laid wherever buried cabling is specified.
m) Taking delivery of the materials from the owner's stores and safe transportation upto the place of erection and excess material back to owner's stores.
n) Opening of packing cases and inspection of the equipment and materials at site.
o) Trial operation of each equipment as per specification, rectifying defects if any and making adjustments as necessary.
p) Handing over of installation for commercial operations.
q) Rerolling of cables on drums if so required by site engineer.
r) Arranging plate inserts wherever required.
s) Making as built drawings.
t) Cleaning of all equipment under erection and work area at regular intervals to the satisfaction of owner's engineer.
u) Carrying out of Touch up painting of equipment, including the supply of paint.

3.0 Foundation and Civil works

3.1 Equipment foundations, concrete part of the cable trenches and other civil works will be carried out by the civil Agency.

3.2 The erection Agency shall check those foundations before commencement of erection to ensure their suitability.

3.3 All final adjustment of foundation level, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts sills, inserts and fastening devices shall be carried out in coordination with the civil Agency.

3.4 Any cutting of masonry work, which is necessary shall be done by the Agency at his own cost and shall be made good to match the original work. The Agency shall obtain prior approval before cutting any masonry/concrete work.

3.5 The Agency shall make his own arrangement for pumping out water that may accumulate in any excavation or Trenches.

3.6 All cable entry openings shall be properly sealed to prevent water seepage from outside trenches/conduits into the building. The required materials for doing so shall be included by Agency in the cable laying prices.

4.0 Instrument Calibration Procedure

Note: Erection Agency shall ensure the availability of O&M manuals and Manufactures test certificates for all instruments/ equipment's under calibration. Erection Agency shall calibrate all field instruments in workshop, before field installation.

4.1 Necessary calibration report shall be generated for each tag/instruments and shall obtained BHEL/IOCL approval before installation.

4.2 Transmitters & gauges- It shall be calibrated for 5-point calibration i.e. raising 0%-25%-50%-75%-100% and back as per calibration range. Repeating the calibration thrice shall check output repeatability. All calibration ranges for transmitters shall be as per relevant project specific document (Instrument index). It shall be calibrated by connecting air or nitrogen to transmitter process flange. Electronic calibration by connecting external signal source to transmitter's electronic is not allowed. Agency shall arrange nitrogen cylinders/pressure regulators etc. For displacer type level transmitters, electronic calibration is allowed.

4.3 All gauges shall be calibrated with reference to Master test gauge. Test Header etc. shall be arranged by contactor.

4.4 Smart type transmitters- First transmitter shall be calibrated with calibrator and it shall be verified by physical calibration using air or nitrogen. Calibrated information shall be stored in calibrator, for each tag.

4.5 Field switches- It shall be calibrated for its raising/lowering set point as per relevant project document. Repeatability shall be checked thrice, for its operation. Calibration report shall be generated for each tag.

4.6 Control Valve/On-Off SOV Valves – Its leakage class, stoke length, actuator & positioner operation shall be checked in workshop. It shall calibrated for 5-point calibration i.e. raising 0%-25%-50%-75%-100% and back as per calibrated range. Repeating the calibration thrice shall check output repeatability. Valve shall be calibrated by connecting 0.2 to 1 kg/cm2 air or nitrogen signals to its positioner and valve strokes for 0%-25%-50%-75%-100% input signals should be verified. At the same time, output from its position transmitter shall also be verified and correction shall be carry out, if required. All results shall be recorded. For SOV operated valves, operation of SOV shall be checked by energizing & de- energizing SOV coil by connecting the required voltage. SOV port operation, vent & manual reset functions shall be checked and shall be recorded accordingly.

4.7 Mass/ Vertex/turbine flow meters – Electronic calibration shall be carried out by connecting electrical signals to its electronics and 4-20 mA output shall be verified with respect to calibration certificate provided by manufactures.

4.8 Safety Valves- It shall be calibrated for its raising/lowering set point as per relevant project document. Repeatability shall be checked thrice, for its operation. Calibration report shall be generated for each tag.

4.9 I/P or P/I Converter- It shall be calibrated by connecting 4-20 mA electrical signals and its pneumatic output shall be checked. Repeatability shall be carried out thrice. Its air pressure regulator shall be verified and pressure shall be set to required value.

4.10 Analyzer system- All analyzers shall be calibrated along with its sensor/electrode connected to transmitter. Sensor/electrode shall be immersed in Standard solution of various known values and transmitters output & display shall be checked for its correct indication. Repeatability to be checked for a thrice. Results shall be recorded.

4.11 RTD/Thermocouple- It shall be calibrated by connecting the assembly in std. Bridge/signal source and output shall be verified at 5 points (0%-25%-50%-75%-100%) of measuring range with respect standard charts for that type of RTD/Thermocouple. These shall also be calibrated using Hot Bath equipment.

5.0 Equipment Installation

The Erection Agency shall carryout following:

5.1 Unpack and check the system hardware/field instruments/equipments and transport it from site stores and installation at its intended locations.
5.2 Erection of impulse lines from process connection to upto field instruments.
5.3 Carry out the laying of field cables upto control room, system communication network cables (for PLC/DCS) & fabricate and install all supplies, connections and accessories necessary to provide a complete interconnection between all equipments.
5.4 Terminate all interconnecting cables between field and control room, communication network, and power & earth cable.
5.5 Test the hardware, power supplies, cabling and connections.
5.6 Termination of all field cables in vendor's marshalling cabinets, ferruling of cables, loop checking from field sensor to system.

6.0 **Equipment Commissioning**

The erection Agency shall carryout the following:
6.1 Loop checking from control room upto final control element & vice versa as required.
6.2 Performing continuity and insulation test for all cables.
6.3 Cable & cores dressing inside the control room & Junction boxes.
6.4 Re-calibration of field instruments /loop if required.
6.5 Agency shall provide necessary assistance /co-operation to other vendors for system integration, as required.

7.0 Cabling Methods & Scope

7.1 All above ground cables from filed instruments to junction box shall be supported by suitable size of MS angle/ perforated tray. Cable shall be fasten to tray at the interval of ½ meter.
7.2 All underground cables from filed instruments to junction box shall be routed through buried cable conduit. Conduit shall be thoroughly cleaned before laying the cable into it.
7.3 For cables from Junction Box to Control room /field instruments shall be marked at each end close to the gland with cable no. as per cable schedule. Multicore cable shall be marked before entry to cabinet/junction box and also inside the cabinet above & below the gland plate.
7.4 Cross and Direct ferruling philosophy shall be followed for ferruling inside instrument/ the Junction box/cabinet as follows:

Location	Ferrules
At Instrument end	JB No+JBTB+JBTE + Inst Tag+Inst TB+Inst TE
At Junction Box, for cable from field Instrument	Inst Tag+Inst TB+Inst TE + JB No+JBTB+JBTE
At Junction Box, for outgoing multipair cable	Control room panel no+TB No.+TE no. + JB No+JB TB+ JBTE
At control room Panel	JB No+JB TB+ JBTE + Control room panel no+TB No.+TE no.

7.5 Erection Agency shall prepare JB terminal drawing for each JB, indicating tag nos. for instruments, JB TB &TE no, core/pair no of all incoming/outgoing cables. Such drawing shall be laminated and pasted inside the respective field junction box.
7.6 All cable entry openings shall be properly sealed to prevent water seepage from outside trenches/conduits into the building. The required materials for doing so shall be included by Agency in the cable laying prices.

8.0 Cabling & Impulse Piping

8.1 Routing of cables between control room & junction box and within control room panel/switchgear room panels shall be as per project specific cable tray layout drawing.
8.2 Routes of cables & air supply lines to individual instrument from junction box/air-header to be decided at site to suit conditions.
8.3 All cables rising from trenches shall be run in trays.
8.4 All cables from control room panel to junction boxes or direct run to field instrument and from junction boxes to field instrument shall be installed in uninterrupted lengths.
8.5 All junction boxes/Inst air headers shall be located to nearest pillar/ structure/ column.
8.6 Junction boxes/Inst air headers installations shall not obstruct any traffic/passage way nor interface with accessibility or removal of process equipment
8.7 All Junction boxes/inst. Air header shall be easily accessible for maintenance purpose.
8.8 For cables raising from trench & terminating in JB, trays shall terminate 400mm below/up bottom/ top of junction box.
8.9 Whenever possible, air supply lines shall be run below cable tray, using same support. All cables shall be clamped to tray.
8.10 Trays to individual instruments shall terminate as close as possible to instrument. Instrument support may be used to secure tray.
8.11 Tray & airline routes shown on layout are for major routes and shall be followed where possible, but if a route is not practical, an alternative route can be decided at site.
8.12 All site fabricated items, all supports or brackets needed for Installation shall be fabricated and painted by the Agency with two coats of red chromate Zinc primer and two coats of epoxy based paint of shade 631 of IS-5.
8.13 Directly buried cables shall be laid on and covered with sand/riddle with mud protected by brick barriers at sides and pre-cast concrete slabs on top. Location of buried cables shall be indicated clearly by cable marker, made of galvanized from interval of 30 meters and at every change of direction.
8.14 The location of cable Joint if any shall be clearly indicated with cable marks with an additional inscription "Cable Joint".
8.15 Cable termination at the equipment end shall be done by the following methods:
a) Power cables: Crimping (Hydraulic/Manual)
b) Control cables & Signal cables: Manual crimping.
8.16 Each control cable core entering panel / Junction box shall be neatly dressed and served with Nylon cord to keep it in position at the terminal block.
8.17 All cable entry points shall be sealed and made vermin and dust proof. Unused opening, if any shall be effectively closed.
8.18 Damaged galvanized surface shall be coated with cold galvanized paint.
8.19 All equipment after erection shall be touched up where required with coats of finishing paint.

9.0 Mounting of JB's, Cable Trays & Air headers

9.1 Junction box/ Air Header normally shall be mounted to nearest column at operating height. Otherwise it shall be mounted on standpipe.
9.2 Generally, JB's & instrument air headers shall be supported by 50x50x6 mild steel angle frame

10.0 Erection Agency shall arrange their own test equipments, erection tools, workshop equipments, erection consumables etc.
11.0 Erection agency shall carry out cable termination at bother ends of cables/ tubes as specified above

12.0 Documentation

12.1 The erection contractor shall furnish the following along with the Bid without fail.

a) Clause wise Deviation list, if any
b) Testing equipment available list.
c) Material handling equipment availability.
d) References where such works are executed earlier.
e) List of items to be supplied by erection Agency.

13.0 All the items under the Agency's scope of supply shall be of reputed Indian make or imported and shall be indicated in the bid in the sub-vendor's list for each and every item and prior approval of the sub-vendors shall be taken from the owner before taking any procurement action.

14.0 As built drawings

Erection Agency shall incorporate all corrections done during erection & commissioning of the plant and as-built drawing shall be furnished in 6 sets. Typical list is given below, however any other doct required by site in charge/end user shall be furnished by Agency.

a) Cable tray layout drawing.
b) Cable interconnection drawings.
c) Cable schedule/JB grouping.
d) Instrument Hookup drawings.
e) Instrument sub-header drawings
f) Control room Layout.
g) Instrument Tags list

15.0 Impulse Line Erection and Testing

15.1 Impulse line shall be of Alloy steel, Carbon steel, SS pipe & SS tubes as per detail engineering drawing to be forwarded to contractor around one month before actual work.

15.2 The pipe routing after first root valve, supporting, welding, any special test required as per piping welding/ erection procedure etc. & connecting to instrument shall be in C&I contractor scope

15.3 All the testing shall be as per project piping specification & specification for Erection specification for BOP Piping (Spec no. GT57167, Rev 00, Clause- 15) & all the impulse lines are subject to hydro test at pressure same as mother pipe hydro test pressure.

15.4 Welding procedure shall be as issued for piping work for this project & specification for Erection specification for BOP Piping (Spec no. GT57124, Rev 02, enclosed with BOP piping erection specification)

15.5 All weld joint in CS, SS, AS line are subject to 100% radiography test with min two shots per joint

15.6 The impulse line shall be supported at regular interval of 200- 300 mm with U bolts / angles etc.

15.7 Vendor shall generate all testing reports/ documentation required for final acceptance of customer.

16.0 Painting of Impulse line & supporting structures.

16.1 The all non- Stainless steel impulse lines & fittings for instrumentation connection shall be painted as per client's specification. Surface preparation. Primer coating etc as required shall be in contractor's scope.

16.2 Painting shall also have applied for impulse line structure, supports, running channels etc.

16.3 Scope of supply of painting material, execution tools/ devices etc shall be in contractor scope.

16.4 The method of painting, color, quality shall be identical to main mother pipe.

16.5 Steam jacketing, insulation etc if required to meet mother pipe requirements shall be contractor scope.

17.0 GUARANTEE:

The erection contractor shall stand guarantee for all the items supplied by him for 12 months from the date of the completion of the contract and shall procure and install any defective material found during that period.

18.0 Responsibility chart for Turnkey/Supervision packages

For following items, scope of each activity and supply of material is as shown below.

S.No	Activity during material handling	Scope
1	Supply of main equipments as per scope, purchase order & approved drgs	Vendor
2	Supply of Erection material as per scope & approved drawings (cable glands, lugs, cable dressing/ tagging material)	Vendor/ Erection Agency
3	Supply of consumables for commissioning	Vendor
4	Transportation upto Stores	Vendor
5	~~Unloading at site and documentation for material receipt~~	~~Erection Agency~~
6	Supply Verification as per packing list, Transit damage inspection	Erection Agency
7	System Storage at site	Erection Agency
8	~~Custody of items in stores~~	~~Erection Agency~~
9	Issue of Items from BHEL Stores	Erection Agency
10	Shifting of equipments to Intended Locations	Erection Agency
11	Provision of Crane/ handling equipments for Shifting of the equipments	Erection Agency
12	Unpacking of equipments in control room	Erection Agency
13	Base frames stand below false floor fabrication and installation	Erection Agency
14	Installation of equipments at intended location	Erection Agency
15	Supply of Accessories for installation of equipments	Erection Agency
16	Inter equipment Cables, cable glands supply	Vendor
17	Inter equipment/Panel Cable laying and terminations	Erection Agency
18	Connecting power supply to System under the supervision of vendor.	Erection Agency
19	Cable glanding, Lugging, Ferruling, Terminations with in package for signal/ control cables	Erection Agency
20	Cable Lugging, Ferruling, Terminations with in package for Special/ network cables	Vendor
21	Laying of cable from field/ other panels to system	Erection Agency
22	Termination of cable at Field/ other panels	Erection Agency
23	Termination cable at control room panels	Erection Agency
24	Cable trays laying in field	Erection Agency
25	Cable trays laying in control room	Erection Agency
26	~~Erection of system and power on~~	~~Vendor~~
27	Erection Supervision	Erection Agency
28	Commissioning of system	Vendor
29	Commissioning Support	Erection Agency
30	Erection & Commissioning coordination with vendors, customers, BHEL HQ	Erection Agency

31	Loop checking in control room from system to marshalling panel	Vendor
32	Loop checking from field to control room & upto system	Erection agency in co-ordination with Vendor
33	Supervision and acceptance of loop function	Erection Agency
34	General Erection & commissioning tools & tackles for packages	Vendor
35	Provision of Power supply, Inst air, other Utilities	Erection Agency
36	Administration of vendors staff	Erection Agency
37	Special proprietary commissioning tools, tackles on returnable basis	Vendor
38	System handover to customer and protocol with customer	Erection Agency
39	As built documents	Erection Agency
40	Storage and handing over of ordered spares	Erection Agency

***** Erection Agency shall provide Stores, in a closed area with **dust free & rainproof** environment.

19.0 ACTIVITIES REQUIRED TO BE DONE BY VENDOR / ERECTION AGENCY DURING SHUTDOWN

SL No.	Activity of Work	Control System	Shutdown / Post-Shutdown	Responsibility [Vendor / Erection Agency]
1	Installation of add on DCS Controllers of C3000 with required IO's	DCS	Shutdown	Vendor
2	Installation of dedicated Panels and Operating workstations	DCS	Shutdown	
3	Installation of dedicated PDB for new DCS System	DCS	Shutdown	Vendor
4	Installation of controllers and cards selected as per IOCL existing setup [Redundant, Series C and PMIOs].	DCS	Shutdown	Vendor
5	Installation of foundation Field Bus modules (1) considered for hooking up exiting modules (3)	DCS	Post shutdown	Erection Agency
6	Installation of existing HARDWARE modified for inclusion of TGTU-1 package Incinerator & WHB	DCS	Shutdown	Vendor

7	Installation of dedicated Safety Manager Controllers with required IO's for ESD, BMS	PLC	Shutdown	Vendor
8	Installation of dedicated Panels and Operating workstations	PLC	Shutdown	Vendor
9	Installation of controllers and cards are selected as per IOCL existing setup	PLC	Shutdown	Vendor
10	Installation of line monitoring functions in DI's and DO's as per existing IOCL setup	PLC	Shutdown	Vendor
11	Installation of existing HARDWARE modification in TGTU-1 package BMS	PLC	Shutdown	Vendor
12	Addition of IO cards in TGTU-1 BMS package.	PLC	Shutdown	Vendor
13	Interaction of ESD system with DCS through SCADA.	PLC	Shutdown	Vendor
14	Installation of Hard wired Consoles [HWC] of 2 Numbers	DCS/PLC	Shutdown	Vendor
15	Modification of existing HWC for FS-407 & FS-408	DCS/PLC	Shutdown	Vendor
16	Installation of New Common UPS PDB for DCS and ESD system	DCS/PLC	Shutdown	Erection Agency
17	Installation of Existing PDB for non-UPS for DCS & PLC	DCS/PLC	Shutdown	Erection Agency
18	Installation of Dedicated mini UPS for FDAS	DCS/PLC	Shutdown	Erection Agency
19	Inter panel cabling and earthing requirements etc.,	DCS/PLC	Shutdown	Vendor
20	Safenet Network Switch (with SFP) to be replaced in the existing system	DCS/PLC	Shutdown	Vendor
21	Installation of 20% wired spares for IO's	DCS/PLC	Post shutdown	Vendor
22	Installation of field devices IS / NIS / FF / WP / Ex-Proof as per existing philosophy.	DCS/PLC	Post shutdown	Erection Agency
23	Installation of Dedicated HAIL Proprietary firmware software for DCS and PLC as applicable to SRU-3 & TGTU-2.	DCS/PLC	Shutdown	Vendor
24	Integration of new points in the existing systems software such as – IAMS, AMS, SOE, History node, History server, Back up server, OPC server, Large Video screens, Domain	DCS/PLC	Shutdown	Vendor

	controller, RTD BMS, ESD HMI's and DCS HMI etc.			
25	Latest add on licences / patches as released by DCS vendor to be updated in all the existing systems like DCS, PLC and other dedicated systems ex: Historian, AMS etc.	DCS/PLC	Shutdown	Vendor
26	Importing of new devices database in SCADA and uploading in the each controller for DCS and ESD separately.	DCS/PLC	Shutdown	Vendor
27	Third party software's required for HART MUX, FF, Wireless transmitters which were part of new system supplies shall be installated and integrated to all the backend systems.	DCS/PLC	Post shutdown	Vendor
28	Integration of different locations of controllers, Remote IO's through dedicated softwares along with SCADA points.	DCS/PLC	Shutdown	Vendor
29	Replacement of FTE switches (with SFP ports) at supervisory level	DCS/PLC	Shutdown	Vendor
30	Modification of existing TGTU-1 BMS system.	DCS/PLC	Shutdown	Vendor
31	Integration of proposed Fibre network at supervisory level to existing network.	DCS/PLC	Shutdown	Vendor
32	SCADA Points integration of existing and new additions in the common network.	DCS/PLC	Shutdown	Vendor
33	Modification of different hierarchy level physical communication to suit SFP Ports.	DCS/PLC	Shutdown	Vendor
34	Integration of new Controller with existing Controllers of DCS & ESD.	DCS/PLC	Shutdown	Vendor
35	Integration of New Operating System with existing operating station through new SCADA Points / Graphic interfaces.	DCS/PLC	Shutdown	Vendor
36	Accommodating the Third Party signals in the existing and new controllers	DCS/PLC	Post-shutdown	Erection Agency
37	Modification of existing Non-UPS PDB for new panels / workstations / HWCs.	DCS/PLC	Shutdown	Erection Agency

38	Integration of FDAS, GDS, BMS and ESD points in existing safenet Controllers.	DCS/PLC	Shutdown	Vendor
39	Removal of the duplicate tags from Global tags in SCADA point database.	DCS/PLC	Shutdown	Vendor
40	Existing control room layout having Cable trays, base frames, density of each tray to be made handy before shipping of the DCS / ESD Panels.	DCS/PLC	Shutdown	Erection Agency
41	Placing of DCS / ESD Panels directly on the base frame instead of storage.	DCS/PLC	Shutdown	Erection Agency
42	Making availability of OFC cables network prior to FTE switch installation	DCS/PLC	Post-shutdown	Erection Agency
43	Making Availability of new Controllers, IO Cards and marshalling on board for supervisory level verification.	DCS/PLC	Shutdown	Vendor
44	Time Synchronization for all new and add on systems.	DCS/PLC	Shutdown	Vendor
45	Field cabling works, loop checking with DCS / ESD	DCS/PLC	Post-shutdown	Erection Agency
46	Termination of field devices in marshalling cabinets	DCS/PLC	Post-shutdown	Erection Agency
47	Conducting SAT	DCS/PLC	Post-shutdown	Vendor / Erection Agency