TECHNICAL SPECIFICATION

FOR ELECTRICAL/C&I CONTROL AND INSTRUMENTATION ERECTION, TESTING & COMMISSIONING WORKS

OF

ASH HANDLING PLANT

5X800MW YADADRI TPS, TSGENCO

Important instructions to be followed by bidder:

- No technical submittal such as copies of type test certificates, technical literature, etc. is required during tender stage. Any such submission, even if made, **shall not be considered as part of offer.**
- Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification. Any Specific deviation (any such which is contradicting with the specification, relevant IS) shall be mentioned in the deviation format only. Any deviation shall be taken up with customer in the event of order.
- Kindly note that supplier shall not be allowed to revise price bid, if there is no change in technical specifications / quantity from BHEL.
- The bidders are requested to visit the site to assess for themselves regarding the quantum of work and site constraints before bidding. Bidder shall clearly confirm the following point in their offer **"Our representative has visited the site and assessed the present site condition, quantum of work and site constraints".** No issue arising out of site condition or layout will be entertained after order placement.

BIDDER'S STAMP & SIGNATURE

Note: - In case of any technical clarification, please contact us over @Email: nbihani@bhel.in, vrao@bhel.in

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TABLE OF CONTENTS

SECTION	DESCRIPTION	Sheet No.		
A	**GENERAL PROJECT INFORMATION**	**03**	**to**	**03**
B	**WORK REGULATIONS**	**04**	**to**	**08**
C	**SCOPE OF WORKS AND SUPPLY**	09	to	41
C1	Introduction to Packages & Responsibilities	09	to	09
C2	List of Input Documents	09	to	09
C3	Scope Matrix	10	to	11
C4	Material Unloading & Storage	12	to	16
C5	**INSTALLATION (ERECTION)**	16	to	31
C6	**CALIBRATION & TESTING**	31	to	33
C7	**COMMISSIONING**	33	to	38
C8	Supply	39	to	40
D	**PROJECT EXECUTION**	41	to	44
D1	Progress Monitoring	41	to	42
D2	Minimum Office Establishment	42	to	42
D3	Minimum Tool & Tackles	42	to	44
D4	Resource mobilization	44	to	44
LIST OF DOCUMENTS ATTACHED				
BHEL Technical Drawings / Document Name				
Doc-1	Flow Diagrams			
Doc-2	HT & LT -Load List			
Doc-3	Electrical Buildings layouts			
Doc-4	IO list-Tentative			
Doc-5	Interplant AHP tray layout & Sections			
Doc-6	Cable Erection, Cable tray, earthing, lightning Philosophy			
Doc-7	Check list / Protocol / FQP Storage			
Doc-8	Checklist / Protocol/ FQP for Erection			
Doc-9	Checklist / Protocol for Testing			
Doc-10	Checklist / Protocol for Commissioning & Trial Run			
Doc-11	Checklist / Protocol for Handing over			
Customer NIT Specifications		**No of Pages**		
Spec-1	TSGENCO NIT Specification –Volume IV TECHNICAL SPECIFICATIONS – CHP,AHP	225		
Spec-2	TSGENCO NIT Specification –Volume V– TECHNICAL SPECIFICATIONS – Electrical	735		
Spec-3	TSGENCO NIT Specification –Volume VI TECHNICAL SPECIFICATIONS – C&I	622		
Spec-4	Painting	27		
Annex-1	Climatological Data	2		
Man-1	**HSE Plan for the Bidder**	73		
BBU	**Billing Break Up**	16p		

SECTION – A
GENERAL PROJECT INFORMATION

Present proposal is for setting up 5 x 800 MW Yadadri Thermal Power Station, for Telangana State Power Generation Corporation Ltd. with all the facilities for CHP, GHP & LHP. Site is located near Verulapalem village, Damarcherla Mandal, Nalgonda District, Telangana. Basic wind speed as 44m/sec & Seismic zone-3. Climatological table for the region as enclosed in Annexure-1 shall be used for reference.

All equipment (including electrical & C&I) shall be suitable for operating satisfactorily in humid and dusty (coal & ash) atmosphere found in Thermal Power plants.

POWER SUPPLY SYSTEM			
1.1	HT power supply		
	i	Voltage	11kV and 3.3 kV AC
	ii	Voltage variation	±10%
	iii	Frequency variation	+3% to - 5%
	iv	Fault level	40kA RMS for 1 second
	v	Earthing	Neutral grounded through resistance
1.2	LT power supply		
	i	Voltage	415V, 3-Ph, 4 wire
	ii	Voltage variation	±10%
	iii	Frequency variation	+3% to - 5%
	iv	Combined Voltage & Frequency Variation	10% (absolute sum)
	v	Fault level	50kA RMS, for 1 second Symmetrical
	vi	Earthing	Solidly Grounded
1.3	Auxiliary AC Supply for field instruments, solenoid valves, service supply (heater/ lamp/ socket)		
	i	Voltage	1Ph, 50Hz 240VAC
	ii	Voltage variation	±10%
	iii	Frequency variation	+3% to - 5%
	iv	Fault level	50kA RMS
	v	Earthing	Effectively grounded
1.4	Control Supply		
	i	LT Switchboard	110V AC, 1 Ph 50 Hz
	ii	Circuit breakers	220 V DC +10% to (-) 15%, two wire, ungrounded
	iii	Local starter/control panel	240V AC, 1 Ph 50 Hz
1.5	Uninterrupted power supply		240V, 1-Ph, 50Hz
	UPS is envisaged for the following systems only (pertaining to coal and ash handling systems)		
	i. DCS ii. HMIs iii. PLCs		iv. RIOs v. Vibration Monitoring Panels vi. Bunker level monitoring system

For the purpose of design an ambient temperature of 50 deg. C, ground temperature of 30 deg. C, depth of laying of cables buried in ground 90cm, thermal resistivity of soil as 150 deg. c cm/W and relative humidity of 85% shall be considered.

SECTION – B
WORK REGULATIONS

B.1 STATUTORY LICENSES:

The Bidder shall have the following valid certificate:
The Bidder should have the applicable Electrical License for Applicable Voltage System to work in Telangana State.

All necessary certificates and licenses, permits & clearances required to carry out this work from the respective statutory authorities are to be arranged by the Bidder in time to ensure smooth progress of work. Bidder shall arrange inspection of concerned Authority for the installation, testing & commissioning of High & Low voltage equipment covered under this technical specification and obtain their approval in appropriate format prior to charging of the equipment.

Bidder shall be responsible for all necessary liasoning work with Statutory Authority towards the certification of installation and electrical testing & commissioning works. BHEL shall provide technical assistance, drawings & document for submission to Statutory Authority. Bidder shall provide all logistical services in this regard.

B.2 ELIGIBILITY / QUALIFICATIONS OF WORKERS:

The Welders, fitters, electricians, ITI, Diploma, Graduate Testing & Commissioning Engineers and all shall produce their academic qualification / training / Experience certificate for BHEL information. In case the quality of works is not satisfactory, BHEL shall demand replacement and bidder shall do it at the earliest.

B.3 CONDUCT OF MANPOWER:

Before deployment of manpower, bidder should ensure their conduct, character and verify their bio-data to ensure suitability for job. Manpower employed shall not involve in any form of violent activities. Entry to project site shall be with Customer gate passes only. Any relevant details/information/identity, residential proofs of manpower, police verification, to obtain such pass to be furnished to BHEL. Request to be made for revalidation well in advance. The Bidder shall report his manpower on daily basis and get the attendance certified. Manpower shall report to BHEL Site in charge / Site engineer directly every day with all safety helmets, shoes, belts, gloves, eye glasses, masks, etc. If for any reason BHEL finds the conduct, discipline & healthiness of any manpower deputed is not fit for site condition, BHEL shall ask for replacement. Bidder shall do the same without delay.

B.4 HSE POLICY:

Bidder must follow all the BHEL Policies, tools and procedures with respect to Health, Safety, Environment, Quality, Time and Document Management. **Health & Safety** of personnel to be given highest priority. The HSE safety instruction as per Annexure 3 has to be followed. BHEL deserves the right to impose fines.

B.5 APPLICABLE CODES AND STANDARDS FOR ERECTION, TESTING, COMMISSIONING & MAINTENANCE.

Major standards which shall be followed are as below. **(Table 2)**

S no	Code	Description
A1	IS: 8437	Guide on effect of Current Passing Through human Body
A2	IS 9407	Classification of Electrical & Electronic Equipment with regard to Protection against Electric Shock
A3	IS: 3043	Code of practice for earthing
A4	IS: 2309	Protection of buildings and allied structures against lightning
A5	IEEE 80	IEEE Guide for Safety in AC Substation Grounding
A6	IS 10028	Code of practice for selection, installation and maintenance of transformers
A7	IS 10118	Code of practice for the Selection, Installation and Maintenance of Switchgear and Control gear
A8	IS 1255	Code of practice for installation & maintenance of power cables up to and including 33KV
A9	IS 2165	Phase to Earth Insulation Coordination Principles & Rules
A10	IS 4029	Testing of 3 Phase Induction Motors
A11	IS 10810	Testing of Cables
A12	IS 6303	Battery testing
A13	IS 2992	Specification for Insulation Resistance tester
A14	IS 2259	Method for determination of Insulation resistance
A15	IS 822	Code for Testing the Welding.
A16	IS 1477	Code of Practice for Painting Ferrous Metals
A17	BS 6121	Code for Brass Cable Glands
A18	IS 8309:	Compression type tubular terminal ends for AL conductors of insulated cables
A19	IS-14930	Code of practice for Conduit systems for electrical cables & wires
B1	-	National Fire code 2004/2005, Vol 14, USA, NFPA 850
B2	-	Indian Electricity Rules, 1956 with up to date amendment
B3	-	National electricity code, 2011 &
B4	-	National Building Code of India 2016
B5	-	State Factory Rules/Acts
B6	-	Electricity Regulatory Commission Act
B7	-	Indian Petroleum Regulations/Acts
B8	-	Indian Explosives Act/Rules
B9	-	Gas Cylinder Rules
B10	-	Pollution Control Regulations / Acts
B11	-	Labour Law - All Workmen related Acts like Minimum wages, PF, ESI of State & Central Government

Bidder shall also follow any other regulations laid down by the local authorities & Telangana Electricity Board. The applicable Indian Standards for any component/part even if not covered in the listed standards shall also be followed to ensure safety of personnel & equipment and obtain all clearances, permissions and licenses required to carry out the super critical thermal power project.

B.6 QUALITY MANAGEMENT:

Quality in work is mandatory. All measures to provide good quality services shall be accepted by Bidder. Poor quality works shall not be accepted. Equipment installation shall be strictly as per Standard Codes of Practice.

B.7 COMMITMENT MEETINGS & AVAILABILITY:

Bidder Site in charge shall attend all the meetings (internal, with vendors, with customer) as per BHEL instruction and take up the milestone requirements as per discussion in meeting.

B.8 DOCUMENTATION & FORMAL COMMUNICATION:

Bidder shall maintain up to date proper record of the job carried in prescribed format as desired by BHEL engineer at site. Bidder shall submit weekly progress report, and in case the weekly milestones are not achieved in time, Bidder shall depute the required additional resources as demanded by BHEL for the completion of work as BHEL schedule. During contract closing all the documents, materials belonging to BHEL shall be handed over to BHEL with proper documentation.

B.9 WORKING WITH BBU:

B9.1 UNIT RATE FOR SUPPLY ERECTION, TESTING AND COMMISSIONING:

Bidder shall not claim for any hike in unit rate or compensation for executing the works claiming that the unit rate for the item is low. The BBU rate is only for billing purpose. Bidder shall work out every BBU item in detail and provide the total price. In case of any deviation in unit rate far from actual cost to Bidder, bidder shall bring the deviation to the notice of BHEL in pre bid query and get clarification or amendment shall be issued if required. After award of work, no change in Unit rate is allowed and Bidder is bound by contractual terms till Work completion and Contract closing.

B9.2 BILLING:

1. Billing shall not be accepted without Protocols (Storage, Erection, testing, commissioning, trail run, Customer Familiarization Protocols, as per FQP / Check list) finalized at site. It is bidder's primary responsibility to plan, execute, coordinate and get the system inspected and protocols certified from Customer / BHEL.

2. Bidder shall continuously pursue the punch points in erection, testing, commissioning, trail Run, and coordinate for work certification at the earliest.

3. If any item or equipment not covered but requires be erected / commissioned, the same shall be carried out by the bidder. Equivalent unit rate for those item or equipment shall be considered wherever possible from the BOM.

B9.3 EXECUTION & BBU QUANTITY:

Bidder shall execute works only as per BBU quantity and BOM area wise as per layout drawing and cable schedules. For any deviation in BOM, bidder shall not execute without the approval of BHEL. Bidder shall write the deviation to BHEL before execution and get the approval for execution via mail. BHEL shall clarify, rectify the same and give required instructions. BHEL shall update the engineering document and amend BBU items & quantity if required for further execution.

B.10 TIME EXTENSION & LD CLAUSE:

If the completion of work as detailed in the Scope of work gets delayed beyond the contract period, bidder shall provide letter to BHEL for extension of the contract with complete details of balance work & cause of delay. The daily manpower attendance, monthly resource allocation by bidder and Daily / Monthly Work Progress Status with details of available fronts, material availability, BHEL clearance, erection, testing, commissioning status, certified by BHEL shall be the basis for Time extension & LD. BHEL at its discretion may extend the contract depending on the balance work left out. In case of Delay attributable to Bidder, LD shall be applicable as per Commercial terms and conditions.

B.11 THEFT / DAMAGE / MISSING:

Any theft / missing / damage to equipment due to normal climatic events like rain, weather, rusting, repeated usage or movement of workers or equipment etc till erection certification has to be replaced / repaired by the Bidder. Bidder shall take all safety precautions to protect equipment. Bidder shall depute security at his own cost till completion of erection inspection by BHEL. Beyond erection inspection and certification, security of installed equipment shall be claimed under unskilled workers, as per BHEL requirement till locking arrangement or alternate security arrangement is ready.

B.12 PROGRESS REPORT:

Providing Daily manpower & resource report, Daily progress report, Monthly Front Availability and progress report in the BHEL format is mandatory. Also Bidder shall finalize the contract for Supply of electrical items & deputation of Testing and commissioning agency in 2-month advance of project requirement. In case of inactivity of bidder, BHEL deserves right to eliminate the scope of from Bidder and execute at the risk and cost of bidder.

B.13 CERTIFICATE TOWARDS COMPLETION:

Bidder shall invite BHEL / Customer for inspection for erection, testing, charging, commissioning, trail run of equipment, Customer Familiarization and get certified all equipment protocols as per FQP. Only after completion of all protocols, handing over protocol of equipment shall be

submitted by Bidder. BHEL shall review the project requirement area wise and start the handing over procedure jointly with customer. As per BHEL Instruction, Bidder shall coordinate with Customer and complete the handing over procedure. After complete system handing over, BHEL shall provide Work Completion certificate to the Bidder. In case of delay in certification of handing over protocol by customer due to reasons not attributable to Bidder, BHEL shall provide work completion certificate, if all the protocols till customer familiarization works are completed to the satisfaction of BHEL. The work under Bidder scope shall be deemed to have been completed in all respects only when so certified by Resident manager BHEL. The decision of BHEL in this regard shall be final and binding on bidder.

B.14 SOCIAL CONTRIBUTION & LIVING:

It is imperative on Bidder part to join and effectively contribute in joint measures such as Tree plantation, environment protection, health precaution and facilities, contributing towards social up-liftment, keeping good relation with local populace etc.

B.15 CLARIFICATION IN TENDER SPECIFICATIONS:

Bidders are encouraged to raise all ambiguities, conflict in the standard & specification and/or interpretation of clauses, if any, in this technical spec. and its enclosures during pre-bid stage itself. Failing which it shall be understood that bidder has no issue and at later date successful bidder shall have no right to take any technical and commercial advantage out of any ambiguity, conflict in the standard & specification and/or interpretation of clauses. In this regard the decision of BHEL shall be final and binding.

SECTION – C
SCOPE OF WORKS AND SUPPLY

C1. INTRODUCTION TO PACKAGES & RESPONSIBILITIES:

The scope of contract involves Receipt of material from BHEL stores, transportation to erection site, temporary storage at site, Erection, testing, commissioning, unloading, Storage, trial run works of electrical, control and instrumentation system of **Ash handling system (AHP) including FA Silo's, Ash recovery and recycle system** of thermal power plant as per this specifications & BOQ.

The major work is summarized as below

1. Receipt of material from BHEL stores
2. Erection, Calibration and Testing.
3. Statutory Certifications-Getting Electrical Inspector/statutory authority's approval for charging of electrical equipment's as per site requirement
4. Material Receipt, Unloading and Storage
5. Commissioning & Trail operation assistance
6. Supply of Electrical Erection Miscellaneous Items

The work functions are not exhaustive, but shall include all work functions like quality, safety, audit etc. required from material receipt to Handing over to customer.

Any damage to equipment / component / device / cables due to wrong work practice, negligence of bidder shall be rectified / replaced at the cost of Bidder. BBU is only for progressive billing purpose & and it does not limit the scope of Contract. (All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)
All precautions, work regulations required for Material handling, erection, testing, commissioning, maintenance safety of equipment shall be taken care by the Bidder. Bidder shall consider every cost involved in execution till handing over in his quoted price.

C2. LIST OF INPUT DOCUMENTS:

The documents attached with tender are only for Tender Cost estimation purpose. Only important drawings & documents required to understand the scope of work for estimation purpose alone are provided. They are attached as annexures to this specification. BHEL shall provide complete drawings & documents for erection, testing, commissioning works at the time of execution.

Bidder shall conduct all the tests and measurements as mentioned in the checklist / protocol.
The Provided checklist / protocol are not exhaustive, any other test, parameter to be included in the check list shall be included as per customer / BHEL requirement. The Finalized Check list / Field Quality plan with additional checks if any shall be finally provided by BHEL from Site.

C3. SCOPE MATRIX:

The scope of work between BHEL and Bidder is as below- **(Table 3)**

S. No.	Activity	BHEL Responsibility	Bidder Responsibility
1	**Erection**	Installation drawing, Front clearance, coordination with Customer and finalizing the FQP and checks for every individual equipment.	Arranging all tools & tackles, consumables, Transportation from Stores to Site & Installation as per drawing & FQP , arranging for erection inspection after completion of work , erection protocol preparation, rectification of comments and punch points and obtaining certification
2	**Testing**	FQP, Check list finalization with Customer.	Complete testing, wiring scheme checking of equipment, panels and components as per FQP / Check list. Arranging all required tools, battery power, construction power etc for testing. Any Modification in wiring scheme as per functional requirement as per BHEL. Rectification of wiring mistakes in scheme, preparing defect list and ensuring the functional and operational tests of equipment & component. Ensuring final relay setting in relay as per design document / motor rating and testing the same. Dismantling defective equipment / component and shifting to store / repair shop as per BHEL Instruction. Calling the customer for testing witness, noting down the test readings and observations in register, Preparation of Test Reports, protocol, and completing certification.
3	**Charging**	BHEL engineer shall inspect all FQP checks, intimate customer and after satisfaction will give clearance for charging.	Shall charge as per guidance of BHEL/customer in his physical presence.
4	**Commissioning of Decoupled drive / field instruments**	Ensuring technical clearance and technical guidance for drive / solenoid trial decoupled trial operation without running the mechanical / process equipment / system.	Ensuring Field clearance physically for drive commissioning, scheme checking of MCC feeder, Overload relay setting, DCS, VMS, relay panel wiring drawings, as per BHEL document. DCS IO checking & individual field component commissioning from HMI/control desk at Control Room as per FQP. Commissioning / Trial Run Operation of all drives on no load / decoupled trial from Local / HMI station as per scheme and noting the readings under running

S. No.	Activity	BHEL Responsibility	Bidder Responsibility
			conditions.
5	**Commissioning / trial run of equipment on Load**	Ensuring rightness of DCS Logic / HMI , all equipment interlocks , settings, safety and healthiness of drives	Operation, Monitoring, Reporting, Trouble shooting and Assistance in all aspects as per BHEL Instruction till completion of activity.
6	**Commissioning of Sequential trial operation of system as whole**	Ensuring rightness of DCS Logic / HMI, all equipment & process interlocks, Sequence Logic and trial run.	Operation, Monitoring, Reporting, Trouble shooting and Assistance in all aspects as per BHEL Instruction till completion of activity.
7	**Continuous Operation**	Coordination with customer & arranging for conducting each of the above milestones / tests.	Completion of all E&C works & certifications for remote DCS operation with all interlocks and facilitate clearance for conducting COD. Operation, Monitoring, Reporting, and Assistance in all aspects as per BHEL instruction till completion of all activity including availability test.
8	**Reconciliation**		Actual measurement to be provided by Bidder as per installation. In case of anything missed by BHEL in as built drawing bidder shall have record of executed items with quantity for the authenticity of execution. Else items as per BHEL Document shall be used for reconciliation, billing. As built drawing / BOM shall be provided as per changes done at site Bidder shall obtain revised drawing or instruction via mail from BHEL to provide for reconciliation.
9	**Handing Over**	Coordination with customer for handing over	Coordination with customer for inspection and handing over of every system and getting handing over certification. Certification for handing over of keys, Tools & tackles, protocols, as built drawings, O&M manuals , spare parts, etc.

C4. MATERIAL UNLOADING & STORAGE:

1. Bidder shall unload, store for the materials as per BHEL site engineer's direction.

2. Items to be stored in open yard/covered storage Air conditioned / non air conditioned depending on the item as per FQP

C4.1 RECEIPT:

1. Bidder shall be coordinating with BHEL, transporters regarding arrival of materials dispatched for the Project.
2. Bidder shall undertake required coordination and arrange for IN/OUT gate pass for entry of Lorry and driver inside the site premises.
3. Bidder shall check the LR / Package list and assess the unloading arrangement and storage location.
4. For any deviation in packing list and material identified in truck, shall intimate BHEL & Lorry driver and wait for further verification & instruction from BHEL.

C4.2 UNLOADING:

1. Bidder shall take note of the type/nature of equipment, volume, weight, to decide the methodology of unloading, type of arrangement required, precautions/care required during unloading/shifting/stacking.
2. Shall arrange / organize immediately for Crane or other material handling equipment for unloading equipment / materials from trailer / truck. The Bidder shall pay all the hire charges directly to the hiring agency whenever any material handling equipment/services is hired.

C4.3 RE-SHIFTING:

1. Bidder shall re-shift any equipment from buildings, junction towers, pump houses, silos etc. to the store yard / repair shop inside the plant or within 15 kilometres from the Plant premises as per BHEL requirement.
2. The unit rate in BBU is only for One side trip / shifting only.

C4.4 LOADING:

1. Bidder shall shift any equipment from equipment buildings, junction towers, pump houses, silos, store and load the material in to the transporters truck. Arranging transporter is not in bidder's scope.
2. This is applicable only when transportation outside site premises is required for repair, replacement or permanent shifting to other sites.
3. The unit rate in BBU for material re-shifting shall be operated for this purpose.

C4.5 SAFETY IN HANDLING:

1. Bidder should take all necessary care to make safe unloading /shifting/stacking of equipment without damaging it and injury to the working persons and surrounding

property. All necessary required tools and tackles including slings, shackles, crane, trailer, trucks etc. are to be arranged by the Bidder. Equipment/Boxes to be lifted, slings should be put at the prescribed locations/lifting lugs. While unloading the material, bidder shall ensure cranes, hoists of proper rating and usage of proper size of clamps/slings/tools/tackles depending upon volume and weight of the item.

2. All the lifting tools and tackles shall be tested and should have valid certificate for prescribed load. At no circumstance under sized slings, shall be used. Damaged tools shall not be used. Safety protocols required by TSGENCO to be complied.

C4.6 INSPECTION & REPORTING:

1. If required, the wooden boxes are to be broken for inspection. The carpenters should do the opening and closing of wooden boxes carefully. The package materials should be provided with the tag and stored carefully as directed by BHEL engineers.
2. Filing of all received item documents including lorry receipt or invoice etc. original and one photo copy will be handed over to BHEL engineer and one photo copy will be maintained by the Bidder.
3. Preparing inspection report for the materials/equipment received.

C4.7 LIASONING:

1. Material receipt Certificate to be issued to the Lorry Driver / transporter.
2. Liasoning with TSGENCO site office for Material Receipt certificate.
3. Shall provide Material Issue certificate for taking the Material from Store to Erection site.

C4.8 MISSING, DAMAGE & THEFT:

1. Bidder shall give all necessary assistance to BHEL engineer to lodge, settle insurance claim in case equipment/boxes received in damaged conditions, short fall in items as per packing list and in case of theft after material being received at site.
2. Shall undertake required inspections and make all damage report /accident report / theft report / short supply in detail to the satisfaction of BHEL engineer.

C4.9 STOCKING:

1. The unloaded materials shall be shifted to storage area as per the FQP to the satisfaction of BHEL engineer.
2. Proper identification mark is to be made on the box/equipment. Items may have to be unloaded at 2 or 3 different locations based on site area availability and for unloading these items adequate men / facilities with tools and tackles have to be arranged at these locations.
3. All Electrical and instrumentation panels, transformers, bus ducts, battery banks, Computer, printers, tables, chairs, shall be necessarily stored inside the closed store (provided by BHEL). Cables, Cable trays, shall be stored in the open yard.
4. Bidder has to take over the material already supplied to site and new material shall be received and stored properly as and when it arrives to site. Shifting of unloaded materials to open yard store or at covered stores, stacking the materials and keeping them in an orderly way.

5. Equipment stacked should be kept in such a way that easy accessibility should be there for issue of materials and drawing out from the stores.
6. Labelling / tagging the materials / equipment for easy identification.
7. Bidder has to arrange tarpaulin for covering the materials

C 4.10 MATERIAL HANDLING, TRANSPORTATION AND SITE STORAGE

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

C 4.10.1 COLLECTION OF BHEL SCOPE OF SUPPLY MATERIALS

1. BHEL shall issue materials covered in BHEL scope from their stores at site. The bidder shall collect such materials from BHEL stores and transport to site of work (inside & outside of Plant boundary) at their cost.
2. The bidder shall inspect such materials as soon as received by the bidder and shall bring to the attention of the Engineer-in-Charge any shortage / damage or other defects noticed before taking over the materials. Materials once taken over will be deemed to have been received in good condition and in correct quantities except for intrinsic defects which cannot be observed by visual and dimensional inspection and weighing.
3. Upon receipt by the bidder, the responsibility for any loss, damage and / or misuse of such materials shall rest with the bidder.
4. All materials issued by BHEL shall be properly stored and systematic records of receipts, issue and disposal will be maintained. Periodic inventory shall be made available to BHEL Engineer-in-Charge.
5. All materials issued by BHEL shall be utilized as directed by Engineer-in-Charge or most economically in the absence of such direction. The bidder shall be responsible for the return to BHEL Stores of all surplus material, as determined by the Engineer-in-Charge.
6. If the materials issued by BHEL are lost, damaged or unaccounted, the cost of such items shall be recovered from payments to the bidder. However, the bidder shall raise FIR and inform BHEL all details.

C 4.10.2 STORAGE

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

4. Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced when decolonization takes place or regenerated. Bidder shall supply & shall replace.
5. Due care should be taken to ensure that the equipment is not exposed to fumes gases etc. which can affect electrical contacts of relays and terminal boards.
6. The storage room and the equipment should be checked at regular interval of three months to ensure protection from termites, mound growth, condensation of water etc. which can damage the equipment.
7. Bidder shall keep BHEL informed about such problem and try to rectify the problem at their risk and cost.
8. All the instrument, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to site.
9. Packing material shall be retained if the cubicle to be repacked after inspection
10. The loose items supplied for the main equipment falls into various categories like tools, modules, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, PCs, monitors, cable glands, cable ducts, frames etc. are to be categorized and stored separately with proper identification.
11. **Sub-Assemblies:**
    i. All sub-assemblies should be kept in a separate place where it is easily accessible.
    ii. Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should also be kept along with it.
    iii. Sub-assemblies should not be stacked one above the other.

12. Sometimes it may become necessary for the bidder to handle certain unrequired components at Customer's / BHEL's stores in order to take out the required materials. The bidder has to take this contingency also into account. No extra payment is payable for such contingencies.
13. The bidder shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site.
14. Bidder has to arrange required fire resistant tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.
15. The bidder shall take delivery of item, materials and consumables from the storage yard / stores / sheds of BHEL / customer which are within a radius of 15 kms, after getting approval of engineer / customer in the prescribed indent forms of BHEL / customer. He shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to them till they are fully erected, tested and commissioned.
16. Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipment from customer stores / storage yard also. Bidder's Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / manpower including operators, Fuel lubricants etc for loading & unloading of materials will be in the scope of bidder.

The equipment / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

C4.11 DOCUMENTATION:

1. All the documents related to gate pass of transporter / BHEL materials shall be carried out by Bidder.
2. The Material Register shall be updated after every Material In & Out. All the entries should be made in the daybook format issued by BHEL in the Day – Register as well in the computer. Maintaining hard copy & soft copy of day-register is must. Bidder should able to give day-register hard copy/soft copy to BHEL immediately whenever it is required.
3. The material Inspection / Damage / theft / short supply report shall be generated for every LR as per packing list.

C4.12 EQUIPMENT CHECK LIST FOR ISSUE OF EQUIPMENT:

1. Before Issue of Cable drums (Power) - IR test to be conducted for the whole drum to ensure that the cable drum is healthy before issuing to Vendor.
   For Control & Screen cables - continuity tests to be conducted.
2. Before issue of Bus ducts & Transformers - IR test to be conducted.
3. All electrical items shall be inspected for any physical damage.
4. The quantity of Cable tray accessories (Coupler plates & Hardware) shall be mentioned in the Material Issue Challan.
5. The Cable trays shall be issued in numbers (with tonnage) Steel channels / angles also in numbers & length (with tonnage)

Above check list shall be inspected and the same to be registered in the MIC document. Without complying to check lists material shall not be Issued for erection. In case of any defect, BHEL has to be informed to ensure that item can be issued or repair to be done before installation. Only after the confirmation of BHEL, the material shall be issued.

C5. INSTALLATION (ERECTION):

The erection scope of bidder starts from identification of items at stores / yards, checking, reporting the damages if any, shifting of material from store, verification, inspection as per shipping list, drawings and documents, pre-assembly, calibration, checking, Installation, Preservation, up keeping, safe custody of the erected equipment till handing over to the customer.

All the items in the BBU, shall be erected in line with FQP, Checklist, Technical Specification & NIT specification of TSGENCO. In case any equipment is wrongly installed, shall be removed / dismantled and reinstalled to comply with the design requirement at bidder's expense.

C5.0 – ERECTION OF EQUIPMENTS

C5.0.1. FOLLOWING ARE THE GENERAL CHECKLISTS FOR ERECTION:

1. Check the name plate details of equipment and match with the requirement as per drawing.
2. Check the material availability as per BOM of equipment.
3. For any shortfall or damage the defect list to be provided to BHEL in writing in the prescribed format as per FQP.
4. Check the erection front readiness, FGL level, centre line from reference points, clearance from sides front & back as per drawing.
5. Assembly of items/components, if required, shall be done by bidder
6. Any fouling with beams shall be taken care during erection of panels. If required core cutting of slab has to be done in some places as per site requirement. Core cutting machine required for the above works shall be arranged by contractor as per technical/ project requirements at site
7. In case of any mismatch in alignment/level packing material shall be provided to ensure uniform panel height without any extra price claim.
8. If there is any deviation, which cannot be adjusted for erection & alignment of equipment must be brought to the notice of BHEL and joint inspection to be done.
9. When the front is ready for erection, shift the identified equipment with all accessories as per GA / BOM from store to installation location with required crane / hydra.
10. Depute required manpower with skilled supervisor for shifting / erection activities.
11. Depute security as per BHEL instruction. Necessary arrangements for Protecting and safe guarding the Erected equipment from any damages and pilferages.
12. The miscellaneous works like chipping, breaking, drilling, levelling etc. shall be undertaken by Bidder for proper erection of equipment.
13. The required hardware, clamps for erection and fixing of equipment is in scope of bidder.
14. Permanent nomenclature by paint on individual feeders/Trays/ HT & LT panels/LT Equipment/other Systems as per site requirement, earth pits and display of safe operating procedure (SOP) for HT & LT MCC's.
15. Bidder shall intimate regarding daily erection plan to BHEL and arrange for inspection (with tools for measurement of erection quality) and record the inspection observations in the protocol.
16. Erection certification shall be obtained by Bidder from TSGENCO / BHEL within 15 days from the date of installation.

C5.0.2. ERECTION QUANTITY MEASUREMENTS:

1. **APPROVAL REQUIREMENT:**
   The Execution of works shall be as per BOM. The deviation in earthing, steel, cable tray material consumption shall be produced by bidder to the engineering / Site for approval before execution.

2. **MEASUREMENTS:**
   For all payment purposes, measurement shall be made on the basis of the actual execution / physical measurements. Physical measurements shall be made by the Bidder in the presence of the BHEL Engineer. The measurement for cable shall be made on the basis of length actually laid, by noting the meter printed in the cable by manufacturer at both ends. For all site-fabricated steel items such as supports, racks,

frame, canopy etc. physical measurement shall be made and then converted to tonnage.

3. **RETURN OF MATERIAL:**
   All the surplus, scrap and serviceable materials, issued to the bidder shall be returned separately as Salvageable scrap (be used one time or other at a later date) and Non - Salvageable scrap (the materials that cannot be used at all one time or other in good condition) as directed by the BHEL Engineer.

4. **WASTAGE REDUCTION:**
   The Bidder shall make every effort to minimize wastage during erection work.

C5.0.3. WELDING:

Installation of equipment involves good quality welding, Non Destructive test checks etc. Welder deployed for welding shall have experienced and approved by BHEL and Customer after due qualification process / testing. BHEL reserves the right to reject any welder if the welding is not proper. The welded surface shall be cleaned of slag and painted with primer paint to prevent corrosion. For this paint will be supplied by the Bidder.

C5.0.4. FITTING:

Experienced, skilled technicians shall be deputed for Hardware fixing & fitting of equipment. All the equipment alignment shall be up to the satisfaction of BHEL / Customer during inspection. Any undesirable tension due to misalignment / fitting shall damage the equipment / component & joints mounted inside panels or shall look odd and poor, or shall reduce the performance, hence required rectification be done as per OEM recommendation / BHEL / Customer advise. In all Power bus bar couplings tension shall be measured by torque meter while tightening the hardware as per OEM recommendation.

C5.0.5. DEWATERING:

Bidder shall ensure at all times that the work area & approach / access roads are free from accumulation of water, so that the materials are safe and the erection / progress schedule are not affected. Cable trenches, cable slits in all areas shall be regularly dewatered and debris to be removed for safe working. Also all the erection scraps and extra cut pieces shall be removed from equipment buildings and stored in the place as directed by BHEL. No separate claim in this regard shall be admitted by BHEL.

C5.0.6. HOUSEKEEPING:

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. Bidder shall reinstall 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. Bidder shall clear all the debris in trench and de-water the trenches.

C5.1. EARTHING & LIGHTNING PROTECTION

Bidder shall arrange for earthing works immediately after the work order is issued. All the buildings available need to be earthed on priority basis. Also all the trestle structures to be earthed. Underground earthing of all structures to be done. For bending of earth flats & earth rods bending machine shall be arranged at site by the bidder to facilitate cold bending. The bends formed shall be smooth. Quality earthing is the most important safety measure for electrical system and no deviation is accepted.

A) ABOVE GROUND EARTHING:

Above ground earthing in every equipment floor of Pump house, Compressor house, Chemical House, Silos, Weigh bridge control rooms, MCC Rooms etc. the Earth grid to be made along the periphery of the building. Every Structure Beam has to be tapped to the earth grid in each floor. In all the jointing points, the minimum overlap shall be 200 mm in case of parallel joint applicable in all buildings and along trays in MCCs. Only for grids in the concrete floors in case of right angle turn, complete width (example 75 mm for 75 x 10 flat) shall be overlapped and it shall be welded on all sides throughout the overlap region. In case of cable tray earthing, tapping every 30 meter to be provided to connect all cable trays and the same shall be connected to the Biggest Structure Beam nearby.

B) BELOW GROUND EARTHING:

Similar to above grounding, here also there shall be minimum 200 mm overlapping in all joints including bends. Risers shall be provided for every 20 meter.

EARTH PITS:

UN TREATED EARTH PIT:

Un Treated earth pit has only 1 earth rod (3m 40 mm dia MS rods) which shall be driven below FGL. This earth rod shall be connected to earth grid with the same 40mm dia earth rod, overlapped for 200 mm using the L shaped Earth rod. L shaped rod to be fabricated by the bidder at site using the 40mm dia MS Rod supplied by BHEL. Bidder's scope includes measurement of earth resistance using earth resistance kit.

TREATED EARTH PIT:

Installation of treated earth pit as per IS:3043 including providing concrete chamber with RCC removable cover and nomenclature / identification of the pit. (Only GI pipe shall be supplied by BHEL). Bidder to refer drawings.

In treated earth Pit, there shall be 1 nos- 100 mm dia CI pipe rod.

Bidders scope includes supply & fixing of funnel &wire mesh, filling pit with bentonite, salt & charcoal and sand as per drawing. Supply of bentonite, salt, charcoal also included in bidders scope.

Bidder Scope includes measurement of earth resistance using earth resistance kit.

ELECTRONIC EARTH PIT

In electronic earth Pit, there shall be 4nos treated earth pits forming a square interconnected to each other with 75x 10 earth flat as per drawing.

Bidders scope includes supply & fixing of funnel & wire mesh, filling pit with bentonite, salt & charcoal and sand as per drawing. Supply of bentonite, salt, charcoal also included in bidders scope.
Bidder Scope includes measurement of earth resistance using earth resistance kit.

All the earthing joints shall be fully welded for 200mm overlap portion, except at test points. In the test points also the overlap region of 200 mm shall be maintained and bolted tightly at 3 points. Earth conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode & the equipment to be earthed. Number of joints shall be made as least as possible. The connection between earthing pads/ terminal to the earth grid shall be made short and direct and shall be free from kinks and splices.

The testing of earth grid / earth pit to be done immediately after erection and any rectification work required to enhance the earth pit resistance has to be undertaken immediately.
Salt, charcoal, bentonite also shall be supplied as per BBU / requirement to enhance the earth resistance. Bidder shall undertake all these works to enhance earthing without extra cost.
The earth resistance protocol has to be made for every area earth grid and every treated pit.

C) LIGHTNING PROTECTION SYSTEM

The scope of works for Lightning Protection system includes installation of vertical air terminations, Horizontal conductors, vertical risers, down conductors, test links, earth electrodes, earth pits, supply of saddles & clamps, minor civil works etc.

Horizontal and vertical down conductors: The horizontal conductors shall be installed on the top of the building with suitable clamps/saddles arrangements. This horizontal conductor shall be connected with down conductors which in turn will be connected to risers through test links. Both horizontal and down conductors shall be supported on the clamps/saddles and spacers which will be fixed on the walls/columns or on top of the parapet walls.

Bidder to supply Concrete / Insulator Compound blocks (approx 200mm x 200mm x 75 mm) for resting Lightning conductor at roof along with M6 grouted bolt and nut as per drawing. Clamps for fixing 75*10 GS flat also in bidder scope

The scope of work for horizontal and vertical conductor shall include supply of supports, clamps, saddles, spacers, Anchor fasteners etc.

Test links shall be installed in the vertical down conductors at ground level as shown in the lightning protection drawings. Supply of GI fasteners like washer/bolt/nut required for fixing Test Link and connecting Test Link to earth electrodes through GI Flat by welding also is part of bidders scope

Riser rod and vertical electrode: Riser Rod and Vertical Electrode, of 40 mm dia, in standard lengths, will be supplied by BHEL. The vertical rod shall be made from the standard length for 3

Mtr and driven into earth. The riser rod shall be suitably fabricated as per requirement and connected to the down conductor and vertical electrode.

Excavation of earth for laying of riser rod, welding with vertical electrode and down conductor, refilling of the excavated earth, consolidation etc. are also in bidder's scope. Even if the building plinth area has already been consolidated, the same shall be removed, conductors shall be installed, welded, refilled and consolidated.

The scope of work for vertical electrode shall cover driving into the earth with suitable tools, and welding to the riser rod, consolidation etc.

Vertical air terminations: The vertical air terminations shall be located in different locations of the buildings. The vertical terminal shall mostly be fixed on the top of peripheral wall using a GI base plate of size 150x150x6 mm. The vertical air terminal shall be grouted on the wall and minor civil works required for grouting the air terminals including supply of grouting materials are in the scope of Bidder. Supply of base plates, and related civil works, grouting and supply of grouting materials are part of the scope for vertical air terminations.

C5.2. STEEL / CABLE TRAY FABRICATION & ERECTION:

1. The Steel shall be cut to appropriate size as per drawing provided and Welding shall be throughout the length of overlapping and not a point welding.
2. For Panels, GA to be referred for steel size & dimension for base frame fabrication. Also the site to be inspected for any deviation from drawing requirement.
3. For tray supports, the tray layout drawing to be referred to get the quantity & size of steel required for a particular area.
4. Appropriate chipping, grinding to be done at welded portion to avoid any injury to personal working and touching the structure. Bidder shall appropriately Paint (including supply) at cut / welded portion.
5. Frame installation at site may involve mounting either on concrete floor or wall using anchor fasteners or on steel structure by welding etc. All consumables including anchor fasteners shall be arranged by the Bidder and supply for same is included in quoted price. Supply of all cement, sand etc. required for grouting of supports is in the scope of bidder and is included in quoted price.
6. Gas cutting of tray / impulse pipe support and gas cut holes in frame shall be avoided. Only drilled hole shall be permitted in frame.
7. A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required

C5.3. ERECTION OF CABLE TRAYS:

The scope of erection shall cover erection of all type of trays and its accessories such as coupler plates/fixing plates, anchor bolts, fasteners, Tees, Reducers, Bends (vertical and Horizontal), cross etc.

The scope also covers making offsets by means of cutting standard tray sections and inserting suitable size of trays to match with the existing arrangement.

1. Trays shall be installed as per tray layout drawing. The coupler plates & hardware shall be installed fully and well tightened as per provision provided. Missing of coupler plates, hardware is not acceptable.
2. All the prefabricated trays and tray bends shall be claimed in meters. Other Tray bends are to be fabricated at site as per requirement. Tray bends fabrication shall be claimed as per tonnage. Fabricated portion shall not be claimed in Meters. The length of fabricated tray shall be converted in to tonnage and claimed.
3. The Voltage levels / Tray name as per layout drawing shall be marked at every Equipment Building and in pipe/cable rack with paint (including supply)
4. All cable trays shall be earthed at intervals not more than 30m and shall be connected to nearest earth riser /biggest steel structure.
5. Trays covers shall be erected after completion of cable laying. GI strip clamps are to be used for fixing the tray covers.
6. Welded Joints of trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS 3043. The unit rate quoted shall also include supply of paints, thinner, other consumables and brush etc.

C5.4. ERECTION OF RIGID AND FLEXIBLE CONDUIT PIPES:

The scope of works for conduit includes drilling of the holes on the plates, fixing of the end connectors, providing suitable supports and fixing tag marks wherever specified as required by BHEL. The supply of suitable clamps, bends, fasteners and tag plates are in bidder's scope.

1. The Bidder shall be responsible for properly embedding conduit pipe in concrete floors.
2. Couplers, Saddles, U clamps, Bends, Spacers and hardware shall be installed for rigid conduits.
3. For OFC cable rigid conduit shall be laid on tray and fixed with tray using GI wire at every 1.5m.
4. Opening for Conduit in floors / trenches / walls etc shall be sealed and made water proof by the bidder where ever it is applicable.
5. GI pull wire of adequate size shall be laid in all conduits before installation. 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
6. Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means.
7. For bending of conduits, bending machine shall be arranged at site by the bidder to facilitate cold bending. The bends formed shall be smooth.

C5.5. ELECTRICAL & INSTRUMENTATION PANELS

The scope of work shall include receipt of panels, accessories & spares including rubber mats (with supply in bidders scope) from site stores/yard, inspection, handling of panels, accessories between stores and erection location, storage, erection of panels, accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over.

1. The base channels shall be normally supplied with the switchboards. These will have to be aligned, levelled and grouted/placed in position as per approved drawings. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If grouting bolts are required for the panel, the same shall be supplied by the bidder at no extra cost.
2. Wherever the base channels are not supplied the same will be fabricated and painted at site.
3. Making base frame/ foundation frames/ support frame or structure as per drawing/ procedures, painting of the supports, base channels, placement, levelling, alignment of the items/ panels, fixing its base of the items to foundation/ frames by fasteners, welding is in bidder scope
4. Red oxide primer and finishing paint as per BHEL approved shade and grade is to be applied on the structures/ foundation frames/ support frames.
5. Panels will be delivered in different shipping sections. The bidder shall set each section of equipment on its foundation or supporting structures and assemble the panels as required. Necessary interconnection of busbar, inter panel wiring, etc. will have to be done by the bidder.
6. Removable undrilled gland plates with gaskets may be provided in each panel to facilitate for cable glanding and termination of external cables in the scope of the Bidder.
7. For making holes on removable gland plate or fixed gland plate the Bidder shall use suitable drilling machine. No gas cutting will be allowed. The bidder shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer as part of panel erection.
8. Chequered plates to be used to cover the openings after panel erection.
9. The bidder shall take the panels to the desired locations either through floor openings or temporary openings. No claims will be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.
10. Generally, the panels shall be supplied with complete Relays/ Instruments and other Components mounted and wired. However, if necessary, dismantling of the existing Relays/ Instruments/ Components, making minor modifications in wiring to suit operating conditions, mounting and wiring of new Relays/ instruments / components shall be carried out without any extra cost. Mounting and wiring of any instruments, meters, relays, push buttons, indicating lamps, contactors etc., if supplied loose for safety in transit, shall also be included in the scope of the job.
11. The bidder shall do touch up painting of panels wherever necessary including supply of paints within the quoted rate.
12. In certain cases, Switchboards incomer bus shall be connected to busducts, through adapter box. The bidder shall co-ordinate for proper busbar connection. If any modification is required in the bus conductor for matching busduct busbar, the same shall be carried out without extra cost.
13. Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Variations in depth, height or weight of the panel shall not be considered for payment.

14. The general check list for LT switch gear is as below.

S no	Check Parameters
1	Erection Location as per drawing
2	Base frame, foundation , etc. level check
3	Installation – Level check for Straightness & Alignment
4	Clearance from side, front and back side as per drawing
5	BOM Items as per drawing
6	Inspection of Panel for any Physical Damage of BOM items after opening
7	Cleaning of individual panel & feeders with blower /vacuum cleaner and cloths
8	Coupling of Panels body frames.
9	Power bus Bar / Wirings coupling & tightness
10	Control Bus Bar / Wirings Coupling & tightness
11	Earth bus Bar / Wiring Coupling & Tightness
12	Alignment / straightness after coupling / tightening.
13	Inter panel / Internal wiring terminations
14	Earthing of Electrical equipment
15	Painting of the Support structures & Touch up painting where ever required
16	Proper Door Open Close

After erection of the panels the bidder shall make all interconnection, power connection etc. Bidder shall mount all loose items/short shipped items and shall supply shims required for aligning the panels. Any touch-up painting of surface/ gland plates required shall also be in bidder's scope.

The bidder shall carry out testing and commissioning works with their own testing equipment and testing teams. Testing shall be done under the supervision of BHEL/Customer Engineers.

The commissioning of Switchgear shall also involve the trial runs and commissioning of all connected equipment like motors and drives etc., The bidder will have to keep his people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc., required in the equipment. (Separate rate shall be paid for commissioning of associated electrical drives as per Rate Schedule only once for an equipment). Bidder shall re-commission the equipment once commissioned by him in case a need arises. Bidder will not be paid commissioning charges more than once for same equipment. Commissioning engineers / supervisors with other technicians, helpers as required will have to come in shifts during commissioning of plant as per BHEL's requirement.

C5.6. BATTERY SYSTEMS

A. The charger and batteries are of heavy duty type, capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden/MS stands.
B. BHEL will provide vendor's technical support for commissioning of Battery and Battery charger/ UPS. The bidder shall carry out the works as per instructions of BHEL/ Vendor Engineer.
C. Lumpsum shall be quoted for Erection and commissioning of Battery. No additional payment shall be made for any variation in the number of cells. The rate quoted for erection of battery will include the following works:

1. Collecting the batteries and all the accessories like cable connectors, inter cell connectors, equalizing connectors, rack insulators, fuse box, loop cables etc. from stores and assembling on the racks and fixing all loose supplied items as per drawings.

2. Battery cells to be handled as per standard practice. The cells shall not be inverted and care to be taken to avoid any damage. Battery bank stands installation shall be carried out as per drawing. The connection links to be tightened as per OEM recommendations with the help of torque meter.

3. Each cell of the battery bank shall be inspected for breakage and condition of cover seals as soon as received at site. Each cell shall be filled with electrolyte as applicable in accordance with the Manufacturers' instructions. Battery shall be set up on racks as soon as possible after receipt. The cells shall not be lifted by the terminals.
4. Cabling & Termination of cables between Battery & Charger and Battery & DCDB is in the scope of bidder.

Bidder has to arrange all safety appliances required during acid filling/ charging of battery.

1. Check for the ampere hour rating of the battery
2. Check the voltage of every battery and check the electrolyte level.
3. Check whether required electrolyte is supplied and available.
4. Check for the number of battery cells received & as per Packing list
5. Check whether the battery stand material is fully supplied as per BOM.
6. Check for the hardware supplied for assembling the battery stand
7. Check for the quantity of Copper connecting links for interconnection between two cells
8. Check for the dimension of each cell as per GA & ensure that cells shall be arranged as per drawing.
9. Check the room dimension and clearance availability as per drawing
10. Check for cleanliness of room and dust proof. Clean the room and all battery stand and equipment before erection.
11. If all the above checks are done and found satisfactory, Install the battery stand & Arrange cells on stand
12. Interconnect cells as per drawing and connect it to the Charger / UPS panel
13. Check the cell voltage after interconnection. If any cells are interconnected wrongly eliminate the same.
14. Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles

15. Arranging manpower in shift during battery charging and discharging cycles that may be carried out round the clock as per the code of practice, and conducting other routine tests as per IS under the supervision of BHEL Engineer/Vendor Engineer.
16. Modifications or changes if any for the loose supplied items or any minor changes in wiring.
17. If Voltage across any cell is zero, it has to be note down and to be replaced with healthy cell.
18. If there are no cells for replacements, kindly wait for BHEL instruction.
19. Check the overall Voltage of the Battery Bank
20. Collect all the spares supplied with Battery bank, list it, check as per BOM / Packing list and store as per BHEL instruction.
21. Call for inspection.

C5.7. DRY TYPE LT TRANSFORMER

1. This is resin cast air cooled housed in enclosure, with all embedded temperature element and associated controllers, temperature indicator cum switch.
2. Identify the transformer and all its parts as per BOM as per drawing & Rating.
3. Clean all the transformer in all aspects.
4. Suitable arrangements shall be made to fix Jacking pad for transformers as required.
5. Check the IR value of transformer.
6. If it is satisfactory, shift the transformer to the erection location
7. Care shall be taken so that Marshall box glass doors, or any other parts shall not be damaged / deformed
8. Levelling & alignment shall be under the scope of the Bidder. Dry type transformer and LT PCC incomer panels shall be aligned in such a way that LT bus duct termination is properly maintained
9. Removal, calibration, installation, testing, commissioning of temperature controller and switch shall be under the scope of the Bidder for which the Bidder shall not claim any extra cost separately.
10. Any loose component/ bus bars, neutral CTs are to be assembled by the Bidder without any extra cost.
11. For fixing of wheels of the transformer, BHEL will provide the insert plate on the concrete or provide MS beam/channel on the floor/ceiling. If the above arrangements are not provided by BHEL, the Bidder has to erect the support by fixing the insert plate on anchoring to ceiling/ floor or to provide additional angle/channel. The MS angle and channel will be provided by BHEL, but the anchoring arrangement (e.g. anchor bolts, nut, etc.) are to be made by the Bidder themselves. This type of arrangement is applicable to erection of support structure of LT bus duct also and the quoted rates of bidder shall be inclusive of above work.

C5.8. LT BUS DUCT & BUS DUCT SUPPORT:

The scope of work includes Receipt from BHEL stores/yards, unloading all the busduct materials and accessories and equipment as indicated in the BOM and relevant drawings at the area where the busducts are to be erected, inspection, installation of all the materials, testing and commissioning of total busduct, painting and handing over. Minor civil works like chipping, grouting, including supply of grouting material is also included in the scope of work.

1. The bus ducts shall be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made including assembly of bellows at site.
2. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators and bus bar joints shall be properly cleaned with required chemical (the cleaning agent is to be supplied by the Bidder on free of cost).
3. The contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned with petrol and wiped. Petroleum jelly shall then be applied and bolted connections made.
4. The bus duct enclosures shall be checked for earth continuity and then earthed at required points. The bus duct shall be duly supported between the switchgear and transformer end.
5. The opening in the wall where the bus duct enters the switchgear room shall be completely sealed to avoid rain water entry.
6. Expansion joints, flexible connections etc. supplied by the manufacturer of the bus duct shall be properly connected.
7. The vertical structures shall be assembled, aligned and grouted and the horizontal structures shall be welded with inserts made available as per the layout drawings.
8. The entire run of the bus duct from the switchgear end up to the transformer shall be aligned and erected as per the approved layout drawings and as per direction of BHEL site engineers to avoid any stress either on switchgear terminals or transformer terminals and the entire work is to be carried out only by competent and experienced manpower. Also, wherever bus duct is crossing through wall, it has to be erected with Bracket being supplied along with the bus duct.
9. Extension of embedment if required and erection of required supports structures as detailed in the drawing. All bolts in the joints will be tightened by torque wrench as per approved pressure and subject to approval of the BHEL site engineer. Anti-oxidation compound will be used for bolted joints and will be supplied by the bidder free of cost.
10. Erection of supporting structures supplied along with the bus duct is to be done by the bidder. The painting (e.g. primer and shaded paint) of the bus duct support are in the scope of contract including supply of the paints and payment shall be made as per the applicable item rate of price schedule.
11. For fixing of LT duct support, BHEL will provide the insert plate on the concrete or provide MS beam/channel on the floor/ ceiling. If the above arrangements are not provided by BHEL, the Bidder has to erect the support by fixing the insert plate on anchoring to ceiling/ floor or to provide additional angle/ channel. The MS angle and channel along with the anchoring arrangement (e.g. anchor bolts, nut, etc.) to be made by the Bidder themselves. This type of arrangement is applicable to installation of dry type transformer also and the quoted rates of Bidder shall be inclusive of above work.
12. If there is any mismatch or inadequacy of the holes on the bus duct flange, the same shall be drilled at site to facilitate matching of bus duct flange with Transformer or PCC/MCC flanges without any extra cost.
13. Fixing of Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe, Fixing of flexible joints, seal off bushing, rubber bellows, CTs wiring, conduit/ GI pipes breather tapping etc., after testing.
14. Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost. (Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures)
15. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.

C5.9. CABLE LAYING:

1. **SAFE HANDLING**:
   Cable drums shall be unloaded, handled and stored on hard and well drained surface so that they may not sink. Rolling of drums shall be avoided Check for physical damage continuity & insulation resistance before shifting for installation. **Cable installation shall be carried out as per IS:1255 and other applicable standards.** For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels. While laying cable, ground rollers shall be used at every 2 mtr interval to avoid cable touching ground. Pulling tension shall not exceed the values recommended by cable manufacturer. All possible care shall be taken to avoid damage due to twist, kink or sharp bends. Minor chipping of concrete floor cutout below panels in order to align the panel's gland plate with the floor cutout shall be done without any extra cost by the bidder.

2. **EXACT MEASUREMENT & REDUCING WASTAGE:**
   The exact route length between various equipment /panels as per the cable schedule shall be measured. Depending upon the route length and the type of cable required for various destinations, the cable drums shall be suitably selected for cable laying. Cable drums shall be utilized one after other and data shall be recorded as per FQP. All measures / planning to be done by bidder to reduce the wastage of cables and straight through joints. **Any jointing** shall have to be approved by BHEL Engineer.

3. **TRAY SEGREGATION AS PER VOLTAGE GRADE & WORKING / STANDBY SYSTEM:**
   Cables shall be laid on cable trays strictly in line with cable schedule furnished to ensure reliability. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, buried in ground, cable shafts, etc.

4. **CLAMPS AND STRAPS:**
   Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every 2mtr. Fixing of Trefoil clamps shall be treated as part of laying work. Multicore cables shall be laid in touching formation. The cable clamps required to clamp multicore cables shall be made up of Aluminium strip of 25x3 mm size every 5 meters for horizontal tray and every 2 meters for vertical tray arrangement. For binding the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment. Single core cable used for three phase AC power shall be clamped in trefoil cable at the time of laying itself.
   Trefoil Clamps supply also to be included in quoted price.

5. **UNDERGROUND CABLING:**
   Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/PVC / GI pipe.
   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 as per IS:1255.

6. **EXTRA LOOP:**

In each power cable 2 meter and in each control & screen cable 3meter extra length shall be kept at panel end for future maintenance requirements. Control cable termination inside equipment enclosure shall not be provided any additional loop. Cable wires dressing inside panel shall be very neat and compact. For any rare case of shifting of termination in future, re glanding shall be done for additional cable / wire length. Hence all additional length shall be kept outside the panel, in trench / cable vault.

7. **CABLE TAGS:**
   Cable tags shall be provided on all cables at boths ends & every 10 meters in cable tray. Cable tag shall be of rectangular shape, 2 mm thick aluminium with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280.

   All cables shall be identified at both ends, adjacent to the cable glands. In addition, cable shall be identified at all drop / pull pits, manholes, pull boxes, and at major changes of direction in cables tray / trenches and multilayer racking cable routes.

8. **DAMAGE**:
   The cables damaged by the Bidder shall have to be replaced by the Bidder at his own cost.

9. **SOFTWARE**:
   Bidder to use BHEL Software for reconciliation, consumption & arranging reports. Necessary support shall be provided by BHEL for usage of software at site.

C5.10. CABLE TERMINATIONS:

The scope of termination shall include termination of cables on various panels / JBs / Push buttons etc. installed by other vendors also. The bidder shall co-ordinate with such agencies and do the termination, including drilling of gland plates for fixing cable glands, if required. Re-termination if required during testing / commissioning shall be carried out without additional cost.

1. **SUPPORTING:**
   The higher size (70 / 95/ 120 / 185/ 240 / 300 / 400 Sq mm) cables shall be supported specially near the gland with the clamp so that Complete tension shall be supported by the CLAMP / Support provided below the panel / motor / transformer. This clamp shall prevent tension at termination points.

2. **GLANDING**:
   Glanding shall be done as per standard practice as recommended by the gland supplier. Cable Glands of appropriate size to be selected to ensure firmness: **Gland Plate holes drilling:** The bidder shall punch the gland plates as per cable schedule. Holes shall not be made by gas cutting. The holes shall be true in shape. Unused openings shall be effectively sealed by 2mm thick aluminium sheets. Separate charge is not applicable for this.

3. **EARTHING**:
   Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc. The screens shall be bunched together and terminated at the Electronic earth bus bar in the DCS panel. Insulation tapping of screens shall be done inside DCS panel so that screen shall

not touch the DCS panel body. This shall ensure segregation of electronic earth and body earth.

4. **CABLE STRAIGHT THROUGH JOINT / END TERMINATION KIT:**
The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer instructions.

5. **DRESSING:**
Control cable cores 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. Dressing shall be appropriate for easy identification of the Spare cores in future for maintenance. The bidder shall carry out cable dressing and clamping for all the cables laid by him. However, if cables like illumination cables or any other cables of lesser quantity for which no separate trays have been allotted and are to be laid on the same trays, the bidder shall do clamping of such cables also along with the cables laid by him
After cable terminations, the debris shall be removed on same day.

6. **FERRULING:**
The ferrules shall be printed by using printing machine by bidder. The Details to be printed in ferrule shall be as per the document, while bidder shall ensure alignment.as per left / right / bottom / top entry of the wire. This shall be ensured by bidder after inspection of Panel and accordingly the ferrule shall be printed. For Each core including spare ferrule shall be provided. Sleeves & Ferrules shall be provided for the OFC cables before terminating.

7. **LUGGING:**
Lugging shall be done using proper crimping tools. Bidder shall supply lugs in case of inappropriate crimping and wastage of lugs. The lugs used shall not have bigger size hole for hardware fixing. The surface of lugs & Panel busbar shall have sufficient contact area to reduce the heat generated at termination point. Usage of Lugs with smaller contact area and bigger hole gets burnt due to high current density over a period of time. The lugs being used shall be of standard make and shall be procured after getting prior approval of the brand from BHEL engineer.

8. **TERMINATION**:
All cable terminations shall be appropriately tightened to ensure secure and reliable connections. Where ever shorting links are required in JBs and panels, Bidder shall purchase shorting links and provide as per terminal plan instead of using Wires for looping.

9. **RECTIFICATIONS:**
Bidder shall reverse termination if required to ensure the proper direction of rotation. Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections etc., shall be carried out by the bidder at no extra cost.

C5.11. SITE SERVICES:

Fire proof sealing: As per TSGENCO NIT Specification

Fire retardant Paint: As per TSGENCO NIT Specification

SKILLED & UNSKILLED MANPOWER SUPPLY:

For any type of works which are not included in BBU, but required for the electrical system of AHP (in-plant, Silo area and Dyke area), BHEL ISG may avail the services from Bidder through manpower supply.

C6. CALIBRATION AND TESTING:

Bidder shall provide **Competent Testing Engineer / Agency** for individual equipment Component testing and Operational testing of the electrical, control and instrumentation panel / system of all equipment erected by Bidder and HT motors supplied by BHEL.

Bidder has to conduct testing of all equipment in scope of Bidder as per BBU. **The bidder shall carry out the Testing after installation as per FQP.** In addition, the Bidder shall carry out all other checks and tests as recommended by the Manufacturers / Electrical Standards / BHEL / Customer as required to prove the functionality of the equipment.

The testing shall be conducted before MCC charging plan / requirement and transformer to be charged well in advance to MCC charging to avoid any delay in equipment commissioning activities. Testing team shall be deputed during COD to avoid any interruption / breakdown in plant operations without any additional cost.

Bidder to conduct testing of MCC Breakers, CT's, BPT's, LPT's, CST's, all the relays, DC Bus, AC Bus, Main Bus, Space heater, MFM, REF interlock and simulation, all the feeders (Incomer, B/C, outgoing modules) scheme checking as per scheme drawing, MCC & Bus duct CRM, Numerical Relay settings & logic checking etc, power & control transformers, all commissioning tests for Cables etc.

The bidder shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various components of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits, e.g., closing, tripping, control interlock, supervision and alarm circuits.
All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.

During the testing activities, if any of temporary work such as mounting of test equipment / cabling etc. are required; the bidder shall carry out such work without any extra cost. The same shall be removed after completion of the activity.

TESTING INSTRUMENTS & KITS:

The bidder must have the requisite testing equipment/instruments of his own to complete the job in time. The instruments used at site must be maintained in good working condition with valid calibration / inspection labels. Arranging the instruments like:

1. Primary / Secondary injection kit,
2. 1 Phase & 3 Phase Auto transformer for voltage ratio test / voltage variation for testing.
3. AC Leakage tester,
4. Digital Multi meter, Tong tester / Digital Clamp meter AC/DC,
5. Galvanometer, Phase Sequence Meter,
6. Contact Resistance Kit,
7. Micro ohm meter for winding resistance of transformer / motor
8. Timer Kit,
9. Digital Insulation Tester, Motorized Megger (500V, 1000V, 5000V)
10. Knee Point Test Kit, DC Power Pack,
11. Earth resistance test kit
12. Transformer Test Kit,
13. Numerical Relay Test Kit.
14. HI Potential Test kit for 11kV / 3.3kV HT cables / Motors / Transformer windings
15. Continuity tester
16. Variable DC Voltage Source (0-30V DC, 5A)
17. 220 V DC source with battery for ACB, VCB Breaker / Numerical relay testing.
18. DB loss measuring Meter for OFC cable
19. HART calibrator
20. Non- contact Temperature Gun
21. Vibration Meter

Other test equipment as required has to be arranged by the Bidder. All the testing equipment shall be duly calibrated by NABL/ NPL accredited laboratories/accreditation agencies.

All checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation and commissioning check lists for various electrical equipment e.g. Transformers, breakers, isolators, CTs, PTs, motors, switchgear, relays, meters, CTD's, VTD's, etc. shall be carried out. FQP shall be taken as guidance. Any other test as applicable to prove the function of equipment as per Section B.

Any tests & testing equipment not listed here but required for complete testing of the equipment shall be deemed included in bidder's scope. The list of tests to be conducted are:

1. **Transformer**:
   Winding resistance, IR, turns ratio & Tap position test, Neutral CT, Winding Temperature CT test, Magnetising current, Magnetic Balance, Knee voltage, Vector group test, etc.

2. **HT & LT Motor >=37 kW:**
   Winding resistance, IR, Vibration, Noise, Winding & bearing temperature.

3. **LT Motor < 37 kW:**
   Winding resistance, IR, Vibration, Noise

4. **Motor Feeder:**
   Instantaneous Over current, Time delay over current protection Thermal Over load protection, Unbalance current protect, Earth fault protection, Hot start protection, etc.

5. **Incomer / Outgoing Feeder**:
   Instantaneous Over current, Time delay over current protection Thermal Over load protection, Unbalance current protect, Earth fault protection, etc

6. **Breaker**:
   Contact resistance, IR, Trip & Close Coil resistance, pick up & drop voltage test, Spring charging motor IR, Winding resistance, operational tests.

7. **CT**:
   IR, Winding resistance, Polarity & Circuit Continuity, CT Ratio and Knee Point Voltage Test.

8. **Bus Bars**:
   IR (60 seconds), PI (10 minutes) test.

9. **HT Cable:**
   Hi Potential test, IR (60 seconds) & PI Test (600 seconds – 10 minutes)

10. **LT Cable:**
    IR (60 seconds)

500 Volts Megger shall be used up to 1.1kV Grade
2500 Volts Megger shall be used up to 3.3 kV Grade
5000 Volts Megger shall be used for 11 kV Grade

The testing activity may have to be repeated as per standard practice to obtain satisfactory results. Required heater, lamps, blower to obtain desired IR/PI values shall be in bidder's scope. Preparation and arranging customer certification of joint commissioning protocol/ commissioning reports for all the equipment in bidder's scope.

C7. COMMISSIONING & TRIAL RUN:

Commissioning implies charging of panels, checking the schematic as per FQP / BOM / Drawing / OEM recommendation, trial operation of feeders, equipment, motors under decoupled condition for 8 hours, 8 hours' trial run in coupled condition, continuous integrated sequential operation of system with process interlocks for minimum 8 hours and observing operation for 1-week time, monitoring all electrical parameters (vibration, temperature, noise, current, voltage, DCS signal status, etc.), and ensuring healthiness.

Every Individual equipment, in the Flow diagram, P&ID, HT & LT Load list need to be commissioned with Protocol by bidder as per SCOPE Matrix. The Bidder shall simultaneously start testing & commissioning activities for equipment to match the mile stone activities of the project.

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.

Bidder shall ensure that equipment earthing is proper for personal and equipment safety. It is primary responsibility of Bidder to ensure the equipment functional safety and personal safety as per schematic and interlock protections.

It shall be specifically noted that the bidder may have to work round the clock and in shifts during the pre-commissioning and commissioning period.

Bidder shall be responsible for all work commitment to customer, as per Main Plant Generation Production requirement. The Bidder Site in charge shall facilitate commissioning engineers in all aspects for quality checking, commissioning and handing over of all equipment.

C7.1. COMMISSIONING OF EARTHING SYSTEM:

The earth resistance shall be measured for grid as overall in each MCC areas separately. The earth resistance for Electronic earth pit to be measured separately. The effective resistance of Electronic Earth Pit shall be less than 0.5 ohm and shall be less than 1 ohm for transformer neutral / MCC grid.
Bidder shall arrange salt, charcoal, bentonite for obtaining satisfactory earth resistance.

Bidder shall follow standard testing procedure to arrive at accurate earth resistance values.

Bidder shall check that every Structure leg, every equipment is connected to Grid.

C7.2. COMMISSIONING OF MCC:

Bidder is responsible for complete commissioning of LT Switchgear independently. Shall check the schemes of Incomer, bus coupler, Bus PT, Line PT, Control transformers, Outgoing Contactor, ACB feeders, SFU & MCB feeders and rectify for any defect. The testing & commissioning of every outgoing feeder to be completed before the commencement of cabling works.

MCC INCOMER / BUS COUPLER:

The check list for commissioning are as below. Before Charging Call Customer / BHEL for Charging inspection.

1. Check the IR value of MCC
2. Check physically the tightness of Bus duct / Cable on the Incoming side,
3. Check the LT ACB feeder IR value & ACB electrical functioning.
4. Check the CT wiring tightness and Link positions of the Incomers & Bus coupler

5. Check the Control trip of the protection relay of incomers and bus couplers
6. Check the Incomer Protection Numerical relay settings as per document.
7. Check the MCC earth bus continuity and connection with earth grid.
8. Box up the MCC & Incomer breakers
9. Check that Danger Board / Notice is fixed on the MCC.
10. Obtain clearance from BHEL / Customer for charging the MCC in the prescribed format with all checklists
11. Switch on the ACB and charge the MCC.
12. Check the 3 Phase supply and Indication in the Outgoing feeders.
13. Note down the phase sequence, frequency and voltage at the MCC feeders.
14. Start the TESTING of Outgoing feeders.

MOTOR OUTGOING FEEDERS COMMISSIONING:

1. Check whether the testing protocol of Motor feeder is signed by customer
2. Clean the feeder to start with commissioning
3. Check the Tightness of Male female contacts / cables / wires in the Feeder
4. Check the IR value of cable laid to the motor
5. Check the LPBS cable termination as per Schematic / Cable termination schedule
6. Check the DCS cable terminations as per Schematic / Cable termination schedule
7. Check the On / Off Operation of Feeder from Local & remote with Power cable disconnected
8. Check whether the DI & AI feedbacks to DCS are healthy
9. Check the Over load relay setting is as per name plate details of Drive
10. Get the clearance from respective Mechanical Bidder to connect the power cable
11. Connect the power cable & Space heater cable on both sides
12. Call the Customer / BHEL for Commissioning inspection.
13. Start the drive from Local / Remote for direction Check
14. If the direction is found Ok start the NO load trial Operation of motor / drive for 8 hours
15. Else change the direction of rotation by changing the Power cable sequence and start the No load trial.
16. Note down the starting current, continuous current in all the 3 phases periodically for 8 hours
17. Note down the space heater voltage at the Motor end.
18. Check for all On/Off/ trip indications in the feeder
19. Same procedure applies in case of SFU feeders also.
20. In case of Over load / Numerical relay trip operation, adjust the Overload relay setting as per advice of BHEL.
21. Complete the Commissioning protocol of the DRIVE to be certified from Customer / BHEL.

C7.3. DCS / VMS / RELAY PANELS:

CHARGING:

1. To start with commissioning kindly ensure the DCS panels are cleaned properly, required blower/vacuum blower to be arranged by bidder.
2. Ensure that there shall be No Continuity between electronic earthing and normal panel earthing. If there is continuity, check whether the electronic earthing is touching

inside the panel (through screen cables). Tie all the screens properly, if required insulate with TAPE so that there shall be no continuity between electronic earthing and panel earthing.

3. Check that all the DI/DO /AI/AO modules are Plugged out.
4. Check the DCS panel BOM & wiring is as per schematic drawing and check tightness.
5. Call Customer / BHEL for Charging / Commissioning inspection.
6. Check the Electronic earthing & Body earthing resistance values and get inspected.
7. Check the UPS power incoming Cable IR, continuity, its termination. And voltage
8. Charger DCS panel & Switch on the MCB, in the presence of BHEL engineer, one after other as per his instruction.
9. Check the output voltage of 230/24 voltes DC converter. The voltage output to be adjusted to 24-24.5 volts DC. Charge all the Rack one after other.
10. Check the redundancy of the Power supply as per schematic
11. Charge all the DCS RIO panels & Network panel in similar fashion
12. Check for continuity of OFC / Lan cables etc and establish redundant network communication as per scheme.

DCS / VMS / RELAY PANELS- IO COMMISSIONING:

1. Check the IO List of CHP/LHP/GHP.
2. BHEL shall provide required technical guidance and assistance to the Electrical Supervisor for monitoring and forcing IO signals from DCS Operating Station / Software.
3. Plan for the IO checking area wise as per Commissioning Planning.
4. First step is to commission the relay panel. Check the terminations between DCS & Relay panels. Force the command from DCS to energise relay and check Output Voltage of all relays one after other.
5. Secondly the DI/DO/AI signals from MCC to DCS which are to be checked.
6. Next Loop checking to be done from JB to DCS Digital input module
7. Bidder electrical supervisor shall force the DO signal from HMI as per BHEL instruction and guidance and Voltage up to JB for Relay outputs shall be checked as per IO list / Cable termination Schedule.
8. The field limit switches shall be installed and wired up to JB by package vendors. Bidder shall coordinate with package vendors and shall check the IO from DCS to field Device.
9. Bidder shall check IOs of AHP in similar fashion, system / area wise.
10. Shall operate the drives from HMI as per clearance provided by BHEL.
11. All the required field precautions to be ensured at the equipment side before operating by bidder by taking clearance from BHEL / Package vendors.

The Bidder supervisor, shall complete the termination checking and IO checking from DCS as per priority and complete for whole of AHP

C7.4. BATTERY BANK COMMISSIONING:

Commissioning support of battery chargers (along with battery and accessories) is in the scope of Bidder. Bidder shall support the commissioning activities with necessary man power, tools & tackles.

Bidder shall arrange all interconnecting cables, Portable Battery Discharge Resistor Bank suitable for all batteries for carrying out capacity/discharge test of batteries at no extra cost. During commissioning of battery sets the Bidder has to arrange for necessary skilled manpower round the clock for charging, discharging, etc.

Charging / discharging / recharging shall be carried out 4-8 hours as per OEM recommendation and readings of every cell and total voltage shall be recorded continuously. Generally, readings were recorded 6 times for each of charging, discharge cycle. Bidder shall depute his supervisor & technician for noting the readings – round the clock as per site requirement.

Also, maintenance of battery parameters on a regular basis (periodic maintenance every 3 months) after commissioning till handing over shall be carried out. Periodic maintenance involves cleaning, cell voltage measurement, electrolyte filling, tightness checking, boost charging, replacement of damaged cells with new cell, final cell voltage after maintenance.

C7.5. HT SWITCHGEAR/HT MOTOR/TRANSFORMERS / BUS DUCT TESTING & COMMISSIONING:

3.3kV & 11kV HT Switch Gear Commissioning: Though HT switchgear testing, commissioning is not in scope of Bidder, Bidder shall conduct operational tests as per schematic and check the wiring of DCS/ LPBS / Marshall box wirings to HT switchgear. Shall ensure that the testing of HT switch gear is completed and obtain clearance from HT switchgear testing agency for commissioning of the drive. Shall get required suggestion from HT switchgear testing agency in case of any small trouble shooting requirement and make the HT switchgear ready.

Cleaning the panels before charging with blower etc. shall be in bidder's scope. HT dress for person operating HT breaker during commissioning has to be considered by bidder.

TRANSFORMERS / BUS DUCT

The bidder testing agency / engineer shall undertake testing and ensure the healthiness of equipment for further commissioning. Bidder Commissioning supervisor shall undertake following actions in sequence before charging the transformer

1. On the day or 1 day Before Charging Call Customer / BHEL for Charging inspection.
2. Check the IR value of transformer windings & Bus duct.
3. Check physically the tightness of Power cable on Breaker side and transformer side,
4. Check the HT VCB feeder IR value.
5. Check the CT wiring tightness and Link positions.
6. Check the Control trip from marshalling box to VCB breaker.
7. Check the Transformer Protection Numerical relay settings asper document.
8. Check the Transformer, Bus duct body earthing completion.
9. Check the Transformer Neutral links connection to treated earth pit.
10. Box up the Transformer, Bus duct & HT VCB breaker
11. Check that Danger Board / Notice is fixed on the transformer.
12. Obtain clearance from BHEL / Customer for charging the transformer & Bus duct in the prescribed format with all checklists
13. Switch on the VCB from DCS and charge the transformer

14. Note down the phase sequence, frequency and voltage at the transformer output
15. Note down the starting current and other parameters as per FQP
16. Keep the transformer charged on NO load for at least 2 days.
17. Observe the transformer physical & electrical parameters for 10 % / 20 % / 50% and full loading.
18. **HT MOTORS COMMISSIONING**: Bidder Commissioning supervisor shall undertake following actions in sequence for trial operation of HT motor.
19. Check the readiness of HT switch gear of respective HT Motor. If the HT switchgear is not tested, coordinate with respective agency to complete testing & Obtain the clearance for trial operation.
20. Check the operations of VCB in test mode through TNC switch and from LPBS.
21. Check the Numerical relay settings, CT circuit, CT links, master trip circuit in the VCB breaker.
22. In case of any schematic problem, troubleshooting to be done as per schematic. In case of major problem, the same to be reported to HT Switch gear testing agency.
23. Check the HT cable terminations at Motor & Panel end.
24. Check the earthing of HT motor is connected.
25. Check the greasing of HT motor bearings.
26. The instruments like vibration meter, temperature gun, noise meter are to be made ready.
27. Call the BHEL / Customer & Start the HT motor in presence or permission of testing agency
28. Note the starting current, steady current, vibration, noise and record in register.
29. Continuously every half an hour observes the HT switchgear and Motor for healthy smooth running and note down the readings in register.
30. In case of any deviation in readings from limit, kindly intimate BHEL for further Instructions.
31. If required HT motor covers may have to be dismantled for any rectification.
32. Generate the Commissioning / trial operation protocol for HT motor.
33. Required heater/blowers to be arranged by bidder

C7.6. CABLE COMMISSIONING:

Every cable shall be tested as per FQP. Only the tested and Customer certified cables shall be accepted for further charging of panels, drive running etc and billing.

IR values are required for LT Power cables, while HI pot is additionally required for HT cables.

C8. SUPPLY:

Any material supplied by bidder (whether billable or non-billable) must be of approved make and strictly as per customer NIT specifications only wherever defined in contract and shall meet the BHEL technical requirements. Item make approval shall be obtained from BHEL, wherever not available.

Before procuring any such material bidder shall mandatorily take approval from BHEL for quantity and make.

Bidder shall supply all types of erection accessories, tools and plants which are required for fine installation of equipment. Bidder shall go through FQP, technical spec of every item mentioned in BBU and get clarified regarding installation services and the accessories required. Same shall be considered in his price.

C8.1 GI PIPES & FLEXIBLE CONDUITS:

Conduits shall be of rigid steel, hot-dip galvanized, furnished in standard length of 5 metres, threaded at both ends Conduits diameter up to and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm. Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.

The bidder shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes etc. complete with accessories such as tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps etc as required for the cabling work.

Steel conduits with interior coating of silicon epoxy ester for ease of wire/cable pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanized. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS: 9537. Flexible conduits shall comply with IS:3480. They shall be made with bright,
cold-rolled, annealed and electro-galvanised mild steel strips. Flexible conduits shall be used between embedded conduits/pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.

The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded. Steel conduits shall be seamed by welding and flo-coat metal conduit/hot dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS: 9537 Part-II.

Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run. Conduits shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.

Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to

expansion or contraction of conduit run. Conduit lengths shall be joined by screwed couplers. Couplers shall be clearly cut.

C8.2 CABLE GLANDS:

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS:6121 and be of robust construction capable of clamping cable and cable armour firmly without injury to insulation. Cable glands shall be made of heavy duty brass, machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 microns. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality.

C8.3 CABLE LUGS:

Cable lugs for power cables shall be long barrel tinned copper solder less crimping type conforming to IS: 8309 suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper conforming to IS: 8309. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. The ferrules shall be indelible interlocking type and shall fit tightly on cores.

C8.4 CABLE JOINTING & TERMINATION KITS:

HT & LT Jointing Kits – Shall be of approved make. Bidder shall provide heat shrinkable Jointing kit for armoured cables as per standard practice and technical specification. Datasheet/QAP to be submitted by bidder for BHEL/TSGENCO approval. Same shall be inspected by BHEL/BHEL TPI.

C8.5 RUBBER MATS FOR INSULATION:

Specifications as per relevant IS 15652:2006.

C8.6 FIRE PROOF SEALING & FIRE RETARDANT PAINTS:

Strictly as per customer specifications.

C8.7 MISCELLANEOUS:

In addition to items mentioned in BBU

Bidder shall consider supply of all required cable dressing related items like Ferrules, sleeves, ties, tags, clamps, paints etc.

SECTION D
PROJECT EXECUTION

D.1 PROGRESS MONITORING:

Daily Progress report: It is primarily responsibility of Bidder to prove and justify his work progress. **Bidder shall report daily rate of work progress as per below table.**

S no	Description	Actual rate of work	Project schedule	Front status / corrective action
1	Earthing			
2	Earth Pits			
3	Steel			
4	Tray			
5	Cabling			
6	IO signals testing			
7	Panels			
8	Equipment			
9	Drives			

Monthly Progress Report Bidder shall provide work progress area wise as below and obtain % Work completion certification from BHEL on Monthly Basis

S no	Areas available for Electrical Execution	Front / BHEL Clearance Date	% Erection as on date	% Testing & Commissioning
CHP Areas				
1				
2				
3				
4				
5				
LHP & GHP Areas				
1				
2				
3				
4				
5				

Bidder shall provide Daily Manpower / resource Availability on daily basis. Below format shall be maintained for progress monitoring.

Daily Resource Report		Day in the month											
S no	Manpower Description / Days	1	2	3	4	5	6	7	8	9	10	11	12
1	Site In charge												

2	Erection Engineer												
3	Erection supervisor												
4	Quality & HSE - Safety Officer												
5	Commissioning Engineer												
6	Commissioning assistance												
7	Electrician												
8	Welders												
9	Fitters												
10	Workers												
11	Security												
12	Safety Belts, Helmets,												
13	Tools & Plants complete list												

Bidder shall mandatorily provide daily resource report, daily progress report, Monthly Report along with Front availability status.
In case of non-availability of resources causing Delay and has impact on progress of the project, BHEL shall depute other agency / resources to complete the required works at the risk and cost of Bidder. Bidder shall deploy manpower on emergency basis to meet the mile stone requirement.

The mechanical equipment's O&M engineer's deputation shall be undertaken only after the readiness of electrical power & control circuit testing & commissioning. Hence electrical works shall be completed well in advance. Accordingly, no relaxation in the execution of Electrical works is accepted.
Bidder shall assume the same while considering his rate, for immediate resource allocation for fronts available to him and completion at the earliest.

D.2 MINIMUM OFFICE ESTABLISHMENT:

Bidder is required to have his own office & temporary stores with security to take care of the material drawn from stores for which he is responsible till handing over to Customer (Necessary co-ordination shall, be in Bidder's scope of work).

Bidder shall maintain following min. items to maintain stores/erection records.

1. PC with latest specification-1No
2. Printer-1 No
3. Computer furniture (Table and chair) for 1 set.
4. Office furniture as required

D.3 MINIMUM TOOLS & TACKLES:

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

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

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

2. Earth resistance tester 0 to 1, 10, 100 ohms
3. Transformer oil test kit (if required)
4. Torque wrench
5. Voltmeter AC 0 - 125 - 250 - 625 V AC
6. Ammeter AC 0 - 2A - 10A AC
7. Wattmeter - ac/dc - 0 - 125 - 250 V 0-5-10A.
8. Multimeter - analogue: AC V 2.5V - 2500V, AC A - 100 mA - 10 A
   DC V 25.V - 2500V, dc A - 50mA - 10A
9. Digital Multi meters (make: Fluke) AC 0V-600V, DC 0V-300V
10. Resistance - 0 - 200 M ohms
11. Digital: voltages AC & DC - 100mv - 1000 V
12. Current 10-mA - 10A Resistance - 0-20 M ohms
13. Oil Filtration Machine 1 kl/hr for Oil filtration -High Voltage Rectifier transformer (if required)
14. VARIAC - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A.
15. Primary injection kit - 0-10000 A.
16. Relays testing kit for Secondary injection test (Make: Omicron)- 0-5A.
17. HV Test kit - 50 KV AC 400kVA.
18. Wheat stone bridge - 0.05 m ohm - 100 ohm.
19. Oscilloscope
20. Air compressor (if required)
21. Oil Tank for transformer oil filtration (if required)
22. Winding inductance/capacitance test kit
23. 220V DC power pack for control supply required for testing of panels
24. Vacuum pump (if required)
25. Phase sequence meter - 110V - 450V - 25 to 65Hz.
26. Frequency meter - 0 - 115 - 230 - 4500 - 45 - 601/s.
27. Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.
28. Tachometer etc.
29. mA Source
30. Standard pressure gauges – If required
31. Temperature oil bath– If required
32. 3 Phase relay testing kit (Of type omicron etc.) To be brought when required
33. Contact resistance measurement kit
34. Micro Ohm meter
35. Equipment for DGA test on Transformers (Guidelines attached in elsewhere in this specification)
36. HT discharge rod (min 11 kV) – 3 sets (min)
37. Lockout Tagout (LOTO) system for implementing during testing, commissioning & initial operation of Electrical equipment
38. Hand gloves (as required)

These have to be maintained in sufficient number and in working condition and can be taken back after completion of the contract.

Bidder has to supply all erection consumable such as gases, welding electrodes, filler wires, cotton waste, petroleum jelly, chemical agents, lubricants, greases, kerosene, small nuts and bolts, washers,

insulation tape, adhesive materials, clamps, straps, paints etc. for successful erection & commissioning of the project.
Bidder has to arrange all necessary tools and tackles at site for doing all the above activities. Any separate charges are not payable for these.
The bidder shall provide all tools, tackles, implements, mobile equipment such as crane, hydra, trailers, Dewatering pumps, scaffoldings, ladders, Cable Winch ,welding machines, gas cutting, bending machine, hand cart, chain pulley blocks wire clues, hydraulic jack/motorized jack, wooden sleeper, drill machine, crimping, hand/hydraulic compression tools for cable termination, vacuum cleaners, box spanner of various size , Allen key set, Vice etc. which are required for transportation, handling and erection of the plant and equipment.
Special erection tools, if any & if supplied by the manufacturer along with the equipment may be used by the Bidder. Such tools shall be returned in good conditions to BHEL on completion of work.

Other items

1. Provision for Temporary scaffoldings
2. Insulation tapes
3. Paints required for primer coating & final coating and for protective coating. paint of approved colour, consumables like thinner brushes, emery paper etc.,
4. Solder wire (Lead 60/40)
5. Protocol / calibration report sheets as per BHEL format
6. PVC wire marker sleeves and tag plates
7. Panel / JB sealing compound material (for cable entry from bottom / top of panel)
8. Materials required for cable dressing
9. Anchor fasteners for wall mounted cable trays & JBs wherever required.
10. Supply of paints, Ferrules, lugs for sizes up to 2.5 sq mm shall be in the scope of the bidder within the quoted rate.

D.4 RESOURCE MOBILIZATION:

Bidder to note that AHP fronts during erection will be given progressively and works are urgently required to be completed. Bidder is not allowed to wait for all fronts to get ready to start the work. Work has to be started in every available front with the consent of BHEL Engineer at site. Bidder has to consider resource planning accordingly so that erection and commissioning works is not delayed.