TENDER SPECIFICATION

BHEL:PSSR:SCT: 1180

FOR

Handling at Site Stores / Storage yard, Transportation to site of Work, Erection, Testing and Commissioning of HT and LT Electrical Package for Units III & IV of 210 MW set Stage II

at

Rayalaseema Thermal Power Project

(Muddanur) V.V.Reddy Nagar,
Kalamalla Post, Cuddapah District,
Andhra pradesh

PART – I TECHNICAL BID

BOOK NO :

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector – Southern Region
690, Anna Salai, Nandanam, Chennai – 600 035.

NOTE TO THE TENDERER

THE TENDERERS SHOULD SUBMIT RELEVANT / RELATED EXPERIENCE CERTIFICATES / DOCUMENTS SUCH AS LOI, WORK COMPLETION CERTIFICATE , AUDITED FINANCIAL CERTICATES (BALANCE SHEET, PROFIT / LOSS ACCOUNTSETC.,)SIGNED BY CHARTRED ACCOUNTANT RELATED TO QUALIFICATION REQUIREMENTS STIPULATED IN QR / SPECIFICATION ONLY. UNNECESSARY CERTIFICATES / DOCUMENTS SHOULD NOT TO BE ENCLOSED

INDEX SCT : 1180

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector, Southern Region
690, Anna Salai, Nandanam, Chennai – 35

Tender Specification No. BHEL:PSSR:SCT: 1180

Messrs Date:

Dear Sir,

SUB: Handling at Site Stores / Storage yard, Transportation to site of Work, Erection, Testing and Commissioning of HT and LT Electrical Package for Units III & IV of 210 MW set Stage II at Rayalaseema Thermal Power Project, (Muddanur) V.V.Reddy Nagar, Kalamalla Post, Cuddapah District, Andhra pradesh.

Please find enclosed one set of non-transferable tender documents containing - **230** - pages along with general conditions of contract Booklet and for the above work.

You are requested to go through the tender documents, GCC Booklet and offer your most competetitive rate and submit the tender documents duly filled in as per procedure indicated in the tender specification along with requisite EMD of Rs.2,00,000/- (Rupees Two lakhs only) in the form Demand Draft drawn in favour of M/s.Bharat Heavy Electrical Limited Chennai - 35. Bids with Deviations from the tender conditions will be rejected.

A SEPARATE LETTER SHALL BE FURNISHED INDICATING THAT THERE ARE NO DEVIATIONS FROM THE TENDER CONDITIONS (As in Page 8.)

The completed quotations shall reach the office of the under signed on or before 29.03.2006 at 15.00 Hrs. The Technical bids, will be opened on the same day at 15.30 hrs. We shall separately intimate the date for opening the price bids only to those parties who are technically Qualified. You are requested to depute your authorized representative at the time of opening.

ANY REVISION OF RATES / PRICES WHATSOEVER AFTER THE TIME AND DATE MENTIONED IN TENDER SPECIFICATION FOR SUBMISSION OF COMPLETED QUOTATIONS SHALL NOT BE ENTERTAINED UNLESS CALLED FOR SPECIFICALLY BY BHEL.

Kindly acknowledge the receipt of the tender documents and confirm your participation.

Kindly note that BHEL reserves the right to reject any or all tenders without assigning any reason.

Thanking you,

Yours faithfully,
For and on behalf of
BHARAT HEAVY ELECTRICALS LIMITED

SENIOR DEPUTY GENERAL MANAGER / CONTRACTS

This Tender document is not transferable.

Place : Chennai -35

Encl: One set of Tender documents along with GCC Booklet.

BHARAT HEAVY ELECTRICALS LIMITED
(A government of India undertaking)
Power Sector : Southern Region
690, Anna Salai, Nandanam, Chennai – 600 035.

SPECIAL INSTRUCTIONS TO BIDDERS

The Bidder must submit their bids as requested in a sealed cover prominently super scribing the Tender Specification number, due date and time of submission as mentioned in the TENDER NOTICE.

The following information shall be furnished by the Bidder along with their offer (Technical Bid cover)

01. Details of previous experience during the last five years indicating contract value, duration, completion period and present engagement as per G.C.C.

02. Organisation structure of the Company as per GCC.

03. Financial status of the firm enclosing balance sheet and profit and loss account for the past 3 years and certificate from the Company's Banker as per G.C.C

04. Turnover of the Company in last 3 Financial years pertaining to this scope of work only.

05. Latest Income Tax clearance certificate.

06. BIO DATA of key personnel presently in the Rolls of the company and proposed site organization for carrying out the work including deployment of Engineers and Supervisors.

07. Declaration sheets as per Appendix of Tender Specification.

08. Checklist and Schedule of General particulars as per Appendix in GCC.

09. T & P owned/deployment details as per G.C.C.

10. Technical manpower deployment details as per G.C.C

11. Other relevant details as per GCC and checklist.

12. These terms and conditions will be read and construed along with General Conditions of contract and incase of any conflict or inconsistency between the General conditions and the Terms and conditions of the tender specification, the provisions contained in the Term and conditions (NIT, Rate Schedule, Common conditions, Special Conditions including Appendices) shall prevail.

13. *THE BIDDERS ARE REQUESTED TO FURNISH THE DOCUMENTS LIKE COPIES OF LOI'S, WORK ORDER'S ETC PERTAINING TO THE EXPERIENCE INDICATED IN QUALIFYING REQUIREMENTS, AS GIVEN BELOW.*

14. **QUALIFICATION REQUIREMENT**

a) The bidders should have successfully executed Min. capacity of 100 MW power station HT / LT Electrical works consisting of Generator transformer, IP welded type Bus duct of 12KV Class and other related works like HT switch gear , HT cable , Trays and Tray supports , earthing etc., should possess valid license for high voltage electrical installation related to work in the last seven years.

b) The bidders should have a minimum average financial turn over of Rs.115 Lakhs per year in the preceding three years ending on 31.03.2005

The bidder must have earned profit in any one of the last three financial years ending on 31.03.2005 and should have positive Bidder should submit audited balance sheet and profit & loss account of the company for last three years ending on 31.03.2005 in support of above requirement.

c) Notwithstanding the above, BHEL reserves the right to reject any Tender or all the Tenders for the reasons whatsoever beyond our control and the decision of BHEL is final.

LD / Penalty shall be leviable as per the applicable clauses of GCC.

15. TENDERERS HAVE TO FURNISH A DECLARATION SHEET INDICATING THAT THERE IS NO DEVIATION FROM TENDER DOCUMENTS (AS IN PAGE 8) TENDERERS MAY FURTHER NOTE THAT THIS DECLARATION IS A PREREQUISITE FOR BHEL TO CONSIDER THEIR BIDS. BIDS SUBMITTED WITHOUT "NO DEVIATION DECLARATION" WILL BE REJECTED BY BHEL.

16. SAFETY PLAN

Bidder may further note that the submission of safety plan is a prerequisite for BHEL to consider their bids.

BHARAT HEAVY ELECTRICALS LIMITED
(A government of India undertaking)
Power Sector : Southern Region
690, Anna Salai, Nandanam, Chennai – 600 035.

PROCEDURE FOR SUBMISSION OF SEALED BIDS

The Tenderers must submit their bids as required in two parts in separate sealed covers prominently super scribed as Part I "Technical Bid" and Part II "Price Bid" and also indicating on each of the covers the tender specification number and due date and time as mentioned in the Tender Notice.

Part I (Technical Bid) Cover I

Excepting Rate Schedule, all other schedules, data sheets and details called for in the specification shall be enclosed, in part I Technical Bid only.

Part II (Price Bid) Cover II

All indications of price shall be given in this part II Price Bid.

Tenderers are requested to quote their rates, only in the price bid (part II) provided by BHEL. Quoting of rates in any other form / formats will not be entertained.

These two separate cover I & II (Part I and Part II) shall together be enclosed in a third envelope (Cover III) along with requisite EMD as indicated and this sealed cover shall be super scribed and submitted to Senior Deputy General Manager/Contracts at the above mentioned address before the due date as indicated. The Tenderers will be intimated separately in case any clarifications are required.

NOTE:

Tenderers are issued with 2 Nos. of Technical Bids, 2 Nos. of Price Bids and 2 Nos. of GCC booklet., out of which one set of each document shall be retained by them for their reference. Balance one set shall be submitted along with their offer as per procedure indicated above.

EMD amount for this Tender is Rs.2,00,000/- (Rupees Two Lakhs only). This EMD amount shall be submitted in the form of either pay order or demand draft only drawn in favour of M/s. Bharat Heavy Electricals Limited, Chennai – 35.

EMD amount in the form of Bank Guarantee / fixed deposit receipt or in any other form will not be Accepted.

ANY REVISION OF RATES / PRICES WHATSOEVER AFTER THE TIME AND DATE MENTIONED IN TENDER SPECIFICATION FOR SUBMISSION OF COMPLETED QUOTATIONS SHALL NOT BE ENTERTAINED UNLESS CALLED FOR SPECIFICALLY BY BHEL.

Sr. Deputy General Manager/Contracts.

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector, Southern Region
690, Anna Salai, Nandanam, Chennai – 35

TENDER NOTICE

Sealed Tenders are invited from reputed contractors with sufficient previous experience in the under mentioned similar nature of work:

Tender Specification No. BHEL:PSSR:SCT: 1180

Description	EMD
Handling at Site Stores / Storage yard, Transportation to site of Work, Erection, Testing and Commissioning of HT and LT Electrical Package for Units III & IV of 210 MW set Stage II at Rayalaseema Thermal Power Project, (Muddanur) V.V.Reddy Nagar, Kalamalla Post, Cuddapah District, Andhra pradesh.	Rs.2,00,000/- (Rupees Two Lakhs only)

Cost of Tender Documents (Including all Taxes)	:	Rs.1105/-	
Sale Starts on	:	13.03.2006	
Sale closes on	:	28.03.2006	
Due date and Time for Submission	:	29.03.2006	15.00 Hrs.
Date and time for opening Of Technical Bids	:	29.03.2006	15.30 Hrs.

QUALIFICATION REQUIREMENT

a) The bidders should have successfully executed Min. capacity of 100 MW power station HT / LT Electrical works consisting of Generator transformer, IP welded type Bus duct of 12KV Class and other related works like HT switch gear , HT cable , Trays and Tray supports , earthing etc., should possess valid license for high voltage electrical installation related to work in the last seven years.

b) The bidders should have a minimum average financial turn over of Rs.115 Lakhs per year in the preceding three years ending on 31.03.2005.

   The bidder must have earned profit in any one of the last three financial years ending on 31.03.2005 and should have positive net worth as on 31.03.2005.

   Bidder should submit audited balance sheet and profit & loss account of the company for last three years ending on 31.03.2005 in support of above requirement.

c) Notwithstanding the above, BHEL reserves the right to reject any Tender or all the Tenders for the reasons whatsoever beyond our control and the decision of BHEL is final.

LD / Penalty shall be leviable as per the applicable clauses of GCC.

Interested parties can get the Tender documents from the office of the Senior Deputy General Manager / Contracts on all working days by remitting the cost of tender documents either by Cash or A/c Payee Demand Draft drawn in favour of M/s. Bharat Heavy Electricals Limited, Chennai – 600 035. Money order, Cheques and Postal Orders will not be accepted.

The Bharat Heavy Electricals Limited takes no responsibility for any delay, loss or non-receipt of tender documents sent by post and also reserves the right to reject any or all the tender without assigning any reason therefor. TENDER NOT ACCOMPANIED BY THE PRESCRIBED EARNEST MONEY DEPOSIT ARE LIABLE TO BE SUMMARILY REJECTED.

SENIOR DEPUTY GENERAL MANAGER/CONTRACTS

TENDER SPECIFICATION : BHEL:PSSR:SCT:1180

CERTIFICATE FOR NO DEVIATION

I, Of M/s.

hereby certify that there is no deviation from the Tender conditions either technical or commercial and I am agreeing to all the terms and conditions mentioned in the Tender Specification.

SIGNATURE OF THE TENDERER

OFFER OF CONTRACTOR

Senior Deputy General Manager/Contracts
Bharat Heavy Electricals Limited,
Power Sector : Southern Region
690, Anna Salai,
Nandanam,
Chennai – 600 035.

Sir,

I/We hereby offer to carry out the work detailed in Tender Specification No.BHEL:PSSR:SCT:1180 issued by Bharat Heavy Electricals Limited, Power Sector : Southern Region, in accordance with the terms and conditions thereof.

I/We have carefully perused the following documents connected with the above work and agree to abide by the same.

1. Instructions to Tenderer
2. General Conditions of Contract
3. Special conditions of Contract
4. Other Section, Appendices and Schedules

I/We have deposited/forwarded herewith the Earnest Money Deposit/a sum of Rs.2,00,000/- (Rupees Two Lakhs only) vide DD.No. .
Dt. which shall be refunded should our offer not be accepted. Should our offer be accepted, I/We further agree to deposit such additional sum which along with the sum of Rs.2,00,000/- (Rupees Two Lakhs only) mentioned above, to make up the Security Deposit for the work as provided for in the Tender Specification within the stipulated time as may be indicated by BHEL, Power Sector : Southern Region, Chennai – 600 035.

I/We further agree to execute all the works referred to in the said documents upon the terms and conditions obtained or referred to therein and as detailed in the appendices annexed thereto.

DATE: CONTRACTOR:

PLACE: ADDRESS:

Witness with their address

Signature Name Address

PROJECT INFORMATION

1.0	GENERAL	:	Project Information
1.1	Authority	:	APGENCO
1.2	Name of Project	:	Rayalaseema Thermal Power Project St.II (2 x 210 MW Units), Muddanur
2.0	SITE LOCATION	:	V.V.Reddy Nagar Kalamalla Post, Cuddapah Dist AP, PIN 516 312 STD : 08563
2.1	Nearest Town	:	Prodattur (STD – 08564)
3.0	SITE CONDITIONS		
3.1	Climate	:	Tropical – Hot – Humid
3.2	Altitude	:	190 Metres above mean sea level
4.0	AMBIENT TEMPERATURES (DRY BULB)		
4.1	Daily Minimum (Mean)	:	19.1 Deg C
4.2	Daily Maximum (Mean)	:	40.3 Deg C
4.3	Design ambient temperature For continuous rating of meter	:	50.0 Deg C
5.0	RELATIVE HUMIDITY		
5.1	Maximum during monsoon (June to October0	:	49 to 74%
5.2	Humidity during summer (March to June)	:	35 to 60%
5.3	Humidity during winter (November to March)	:	55 to 70%

6.0	RAINFALL		
6.1	Maximum per annum	:	1273.6 mm
6.2	Average per annum	:	742.8 mm
6.3	Tropical Monsoon	:	June to October
7.0	WIND VELOCITY & PRESSURE		
7.1	Maximum Wind velocity	:	175 KMPH
7.2	Basic Design wind Pressure	:	Upto 30 M height : 200 kg /n2
8.0	SEISMIC FACTORS		
8.1	Horizontal seismic co-Efficient	:	As per latest ISS : 1893
8.2	Vertical seismic co-Efficient	:	As per latest ISS : 1893
9.0	Longtitude	:	18 Deg 28’ East
	Latitude	:	14 Deg 42’ 3” North
10.0	Nearest Aerodrome	:	Hyderabad / Bangalore – 300 kms
11.0	Nearest Railway Station	:	Muddanur on Madras – Bombay Railway line

SECTION III

COMMON CONDITIONS OF CONTRACT

3.1 SCOPE OF CONTRACT

3.1.1 The Intent of this specification is to provide erection and commissioning services for execution of projects according to most modern and proven techniques and codes. The omission of specific reference to any method and equipment or material necessary for the proper and efficient services towards installation of the Plant shall not relieve the contractor of the responsibility of providing such services, facilities to complete the project or portion of project awarded to him. The quoted rate shall deem to be inclusive of all such contingencies.

3.1.2 The contractor shall carry out the work in accordance with instructions/ drawings/ specification/ standard practices supplied by BHEL from time to time.

3.1.3 Provision of all types of labour, Supervisors, Engineers, watch and ward as required tools and tackles as required, consumables as required under various clauses of tender specification for handling transportation, erection, testing and commissioning.

3.1.4 Proper out-turn as per BHEL plan and commitment.

3.1.5 Completion of work in time.

3.1.6 Good quality and accurate workmanship for proper performance of equipment / systems.

3.1.7 Preservation of all components at all stages of pre-assembly/erection/testing and commissioning till completion of trial run of unit.

3.2 FACILITIES TO BE PROVIDED BY BHEL:

3.2.1 OPEN SPACE:

Open space for building of temporary office shed / stores shed will be provided free of cost. Contractor has to make his own arrangements for labour colony.

3.2.2 ELECTRICITY:

For construction purpose, electricity will be provided free of charge at one single point. Further distribution shall be arranged by the contractor for the site requirement at his cost.

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

3.2.3 WATER:

For construction and drinking purpose water will be provided at one single point, free of charge, as provided by customer to BHEL. Further distribution shall be arranged by the contractor at his own cost.

3.2.4 TOOLS & TACKLES:

BHEL will provide 75 ton crane – 1 no & 18 ton crane – 1 no for erection of transformer and other works, free of hire charges, as per site requirement on sharing basis, including EOT crane in power house hall. Required crane operators, fuel and lubricants are to be arranged by the contractor at their cost.

All other Tools & Plants and instrument required for the complete erection of components shall be arranged by the contractor at their cost.

3.2.5 CONSUMABLES:

All consumables, electrodes including Oxygen / acetylene, Argon, Gases, Paints etc, shall be arranged by the contractor at their own cost.

3.3 FACILITIES TO BE PROVIDED AND DEVELOPED BY THE TENDERER / CONTRACTOR AT HIS COST.

3.3.1 CIVIL CONSTRUCTION:

It shall be the responsibility of the contractor to construct his own office shed, stores shed, with all facilities like electricity, water supply, sanitary arrangements in the area allotted to him for the purpose.

3.3.2 WATER DISTRIBUTION:

Distribution of water for construction purpose and as well as drinking purpose from the single point provided by BHEL to various work-fronts shall be contractor's responsibility and at his cost.

3.3.3 ELECTRICITY DISTRIBUTION:

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

3.3.4 POSSESSION OF GENERATORS :

As there are bound to be interruptions in regular power supply, power cut / load shedding in any construction sites, due to inherent power shortage in Stage on this account, suitable extension of time, if found necessary only be given and contractor is not entitled for any compensation. It shall be the responsibility of the tenderer / contractor to provide, maintain the complete installation on the load side of the supply with due regard to safety requirements at site. The contractor shall adjust his working shifts accordingly and deploy additional manpower, if necessary to achieve the target. It shall be the responsibility of the contractor to have at least 2 to 4 Nos diesel operated Generator sets to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by the tenderer.

3.3.5 LIGHTING FACILITY :

Adequate lighting facilities such as flood lamps, low volt hand lamps and area lighting shall be arranged by the contractor at the site of construction, contractor's material storage area etc. at his cost.

3.3.6 POWER DISTRIBUTION :

For the purpose of planning, contractor shall furnish along with tender the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.

3.3.7 CONTRACTOR'S OBLIGATION ON COMPLETION :

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

3.4 GASES :

3.4.1 All required gases like Oxygen/ acetylene/ argon/ Nitrogen required for work shall be supplied by the Contractor at his cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of those gases. Non-availability of gases cannot be considered as reasons for not attaining the required progress of erection.

3.4.2 BHEL reserves the right to reject the use of any gas in case required purity is not maintained.

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

3.4.4 The contractor shall ensure safe keeping of the inflammable cylinder at a separate place away from normal habit with proper security etc.

3.4.5 The contractor shall arrange air / gas manifold ensuring proper distribution and reduction of handling time.

3.5 ELECTRODES & FILLER WIRES :

3.5.1 All required electrodes shall be arranged by contractor, at his cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement regarding suppliers, type of electrodes On receipt of the electrodes at site it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch No., and date of expiry etc.

3.5.2 Storage of electrodes shall be done in an air conditioned / humidity controlled room as per requirement, at his own cost by the contractor.

3.5.3 All low electrodes shall be baked / dried in the electrode drying oven (range 375 deg. C – 425 deg. C) to the temperature and period specified by the BHEL Engineer before they are used in erection work and each Welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by the contractor at his cost.

3.5.4 In case of improper arrangement of procurement of above electrodes BHEL reserve the right to procure the same from any source and recover the cost from the contractor's first subsequent bill at market value plus departmental charges of BHEL. Postponement of such recovery is not permissible.

3.5.5 BHEL reserves the right to reject the use of any electrodes at any stage if found defective because of bad quality, improper storage, date of expiry, unapproved type of electrodes etc. It shall be the responsibility of the contractor to replace at his cost without loss of time.

3.6 TOOLS & TACKLES

3.6.1 All T & P required for the satisfactory execution of work shall be arranged by contractor at his cost except those specified in clause 3.2.4.

3.6.2 All the T & P arranged by contractor including electrical connections wherein required shall be reliable/proven/tested and necessary test certificate.

3.6.3 All instruments, measuring tools etc. are to be calibrated periodically as per the requirement of BHEL and necessary calibration certificates are to be submitted to BHEL before use.

3.6.4 All the T & P, lifting tackles including wire ropes, slings shackles and electrically operated equipment shall be got approved by BHEL Engineer before they are actually put on use. Test certificates should be submitted before their usage.

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

3.7 SUPERVISORY STAFF AND WORKMEN

3.7.1 The Contractor shall deploy experienced Engineers, Supervisors all the skilled workmen like High Pressure Welders (gas, TIG and arc) Carbon, alloy steel welders, Gas cutters, electricians, Riggers, Serangs, Erectors, carpenters, fitters etc. in addition to other skilled semi-skilled and unskilled workmen required for all the works of handling and transportation from site storage to erection site, transportation, erection, testing and commissioning contemplated under this specification. Only fully trained and competent men with previous experience of the job shall be employed. They shall hold valid certificates wherever necessary.

3.7.2 BHEL reserves the right to decide on the suitability of the workers and other personnel who will be employed by the contractor, BHEL reserves right to insist on removal of any employee of the contractor at any time, if they find him unsuitable and the contractor shall forthwith remove him.

3.7.3 The supervisory staff employed by the contractor shall be qualified Engineers and experienced in the area of work. They shall ensure proper out-turn of work and discipline on the part of labour put on the job by the contractor and in general see that the works are carried out in safe and proper manner and in coordination with other labour and staff employed directly by BHEL or other contractor's of BHEL's client.

3.7.4 The Contractor shall also furnish DAILY & MONTHLY report showing the number of employees engaged in various categories of work and a progress report of work as required by BHEL Engineer.

3.7.5 The work shall be executed under the usual conditions existing in major power plant construction and in conjunction with numerous other operations at site. The bidder and his personnel shall co-operate with other personnel contractor coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

3.7.6 The contractor's supervisory staff shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work, good workmanship and aesthetic finish are essential part of this contract. The contractor shall be responsible to ensure that assembly and workmanship conform to the dimensions and tolerances given in the drawings/instructions given by BHEL Engineers from time to time.

3.7.7 The contractor shall employ the necessary number of qualified and approved full time electricians at his cost to maintain his temporary electrical installation till the completion of work.

3.7.8 It is the responsibility of the bidder to carryout the work for achieving the target set by BHEL and also during erection, commissioning and testing period. The contractor's quoted rate shall include all these contingencies.

3.7.9 If the contractor or his workmen or employees shall break, deface, injure or destroy any part of a building, road, kerb, fence, enclosure, water pipes, cables, drains, electric or telephone posts or wires, trees or any other property or to any part of erected components etc. The contractor shall make the same good at his own expense or in default.

3.7.10 BHEL may cause the same to be good by other workmen or by other means and deduct the expenses (of which BHEL's decision is final) from any money due to the contractor.

3.8.0 SCOPE OF MATERIAL HANDLING AND SITE STORAGE AND OTHER RESPONSIBILITIES :

3.8.1 While BHEL will endeavour to store/stack/identify materials properly in their open/closed storage yard/shed it shall be contractor's responsibility to assist BHEL in identifying material well in time for erection, taking delivery of the same in time following the procedure indicated by BHEL and transport the material safely to pre-assembly yard/erection site in time according to programme.

3.8.2 The contractor shall identify necessary supervisor/labour for the above work in sufficient quantity as may be needed by BHEL for areas covering their scope.

3.8.3 It shall be contractor's responsibility to arrange necessary cranes/tractors, trailer or trucks/slings/tools and tackles/labour including operators and on to transport equipment, move it to erection site/pre-assembly yard and unload the same at pre-assembly yard/ erection site and the quoted rate shall include the same.

3.8.4 All equipment so used by contractor shall be of proven quality and safe in operation as approved by the statutory authorities as per the law in force.

3.8.5 Any loss/damage to materials issued to contractor shall be made good by him or BHEL will arrange for replacement at cost recovery basis and decision of BHEL shall be final. Any loss/ damage must be intimated to site in-charge of BHEL in writing within 24 hours of the occurrence.

3.8.6 All the surplus damaged, unused materials, package materials/containers/special transporting frames, gunny bags etc. supplied by BHEL shall be returned to the BHEL Stores by the contractor immediately.

3.8.7 The contractor shall take delivery of the components and equipments and special consumables from the storage area after getting the approval of the BHEL Engineer on standard indent forms to be specified by BHEL. At periodic/intervals of work, complete and detailed account of the equipment so erected and electrodes used shall be submitted to the BHEL Engineer.

3.8.8 The contractor shall submit monthly plan for erection and the same will be mutually agreed upon after discussion. The contractor shall arrange for Engineers, Supervisors and labour force and tools and plants and consumables to suit the above plan and execute the work accordingly.

3.8.9 The Contractor shall have total responsibility for all equipment and materials in his custody, stores, loose, semi-assembled, assembled or erected by him at site.

3.8.10 The contractor shall make suitable security arrangement including employment of security personnel to ensure the protection of all materials/equipments and works from theft, fire, pilferage and any other damage and loss.

3.8.11 The contractor shall ensure that the packing materials and protection devices used for the various equipments during transit and storage are removed before these equipments are installed.

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

3.8.13 The work covered under this scope of work is of highly sophisticated nature requiring best quality / proven workmanship engineering and construction management. It should also ensure successful and timely commercial operation of equipment installed. The contractor must have adequate quantity of precision tools, construction aids in possession. Contractor must also have adequate trained qualified and experienced supervisory staff and skilled personnel.

3.8.14 All the necessary certificates and licenses required to carry out this scope of work are to arranged by the contractor then and there at no extra cost.

3.8.15 The contractor shall take all reasonable care to protect the material and work till such time the erected equipment has been taken over by BHEL/their client. Necessary suitable temporary fencing and lighting shall have to be provided by the contractor as a safety measure against accident and damage of property of BHEL. Suitable caution notices shall be displayed where access to any part may be deemed to be unsafe and hazardous.

3.8.16 The contractor shall be responsible for taking all safety precautions during the construction and leaving the site safe at all times. When the work is temporarily suspended he shall protect all construction materials, equipments and facilities from causing damage to existing property interfering with the operations of the station when it goes into service. The contractor shall comply with all applicable provisions of the safety regulations clean-up programme and other precautionary measures which the BHEL has in effect at the site.

3.8.17 All lifting tackles including wire ropes, slings, shackles etc. used by the contractor shall be got approved by BHEL Engineer at site before they are actually put on the work. It will be the responsibility of the contractor to ensure safe lifting of the equipment taking due precautions to avoid any accidents and damage to other equipments and personnel. All piping shall be adequately supported and protected to prevent damage during handling erection. The history cards for major equipments to be maintained by the contractor.

3.8.18 The contractor shall take delivery of equipment from storage yard/stores/sheds. He shall also make arrangements for verification of equipment maintain records and keep safe custody watch and ward of equipment after it has been handed over to him till these are fully erected, tested and commissioned and taken over by BHEL's client. The stolen/lost damaged goods shall have to be made good by the contractor at his own cost.

3.8.19 Sometimes it may become necessary for the contractor to handle certain unrequired components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

3.9.0 PRESERVATION OF COMPONENTS

3.9.1 It shall be the responsibility of the contractor to apply touch up painting on all equipment before erection. It shall be contractor's responsibility to arrange for required labour, brush and other consumables like cotton waste, cloth etc. for carrying out preservative painting. The quoted rates shall be inclusive of above work. The required paint and thinner shall be arranged by BHEL at free of cost.

3.9.2 The contractor shall effectively protect the finished work from action of weather and from damage or defacement and shall cover the finished parts, then and there for their protection.

3.9.3 Any failure on the part of contractor to carry out work according to above clauses will entail BHEL to carry out the job from any other party and recover the cost from contractor.

3.9.4 Due to atmospheric conditions erected materials are likely to get rusted more frequently. It is the responsibility of the contractor to preserve the erection materials drawn from stores for erection till these are commissioned and handed over to customer. All consumables including painting brush, emery paper, cotton waste, cloth etc. have to be procured by the contractor at his cost. The required preservative paint and Thinner shall be arrange by BHEL free of cost. The contractor should ensure that the materials are not rusted on any account till they are handed over to customer. The decision of the BHEL Engineer is final with regard to frequency of application of paint.

3.10.0 DRAWINGS AND DOCUMENTS

3.10.1 The detailed drawing specification available with BHEL Engineers will form part of this tender specification. These documents will be made available to the contractor during execution of work at site.

3.10.2 One set of necessary drawings to carry out the erection work will be furnished to the contractor by BHEL on loan which shall be returned to BHEL Engineer at site after completion of work. Contractor's personnel shall take care of these documents given to them.

3.10.3 The data furnished in various appendices and the drawings enclosed with this Tender Specification, describes the equipment to be installed, tested and commissioned under this specification briefly. However, the changes in the design and in the quantity may be expected to occur as is usual in any such large scales of work.

3.10.4 Should any error or ambiguity be discovered in the specification, or information, the contractor shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor.

3.10.5 Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimensions/details without specific approval of BHEL.

3.11.0 SITE CLEANLINES AND SAFETY REQUIREMENTS

3.11.1 Contractor shall strictly follow all safety regulations/conditions as per clause 2.15 and its subclauses of general conditions of contract booklet enclosed with this tender.

3.11.2 Non-confirmity of safety rules and safety appliances will be viewed seriously and the BHEL has right to impose fines on the contractors as under: BHEL Engineer's decision is final and binding in this regard.

Sl.No.	Safety	Fine (Rs.)
01	Not wearing safety helmet	50/-
02	Not wearing safety belt	100/-
03	Grinding without goggles	50/-
04	Not using 24V supply for internal work	500/-

05	Electrical plugs not used for hand machines	100/-
06	Not slinging properly	200/-
07	Using damaged sling	200/-
08	Lifting cylinders without cage	500/-
09	Not using proper welding cable with lot of joints and not insulated properly	200/-
10	Not removing small scrap from platforms	200/-
11	Gas cutting without taking proper precaution or not using sheet below gas cutting	200/-
12	Not maintaining elec. Winches which are being operated dangerously	500/-
13	Improper earthing of electrical T & Ps	500/-

3.11.3 The contractor should exclusively deploy one Safety Engineer along with a safety supervisor for effective implementation and co-ordination of safe working conditions.

3.11.4 Contractor shall necessarily fill up the safety plan format available in general conditions of contract booklet enclosed with this tender and submit along with their offer.

3.11.5 CONTRACTOR SHALL DEPLOY A SAFETY OFFICER EXCLUSIVELY TO HANDLE SAFETY REQUIREMENT.

3.12.0 PROGRESS OF WORK

3.12.1 During the course of erection if the progress is found unsatisfactory or if the target dates fixed from time to time for every milestone are to be advanced or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians etc. employed are not sufficient, BHEL will induct required additional workmen to improve the progress or take over a part of the job and get it done on risk and cost of the contractor and recover from contractor's bill, all charges incurred on this account including all expenses together with BHEL overheads from contractor's bill.

3.12.2 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, material reports, consumables reports and other reports considered necessary by the BHEL Engineer.

The manpower reports shall clearly indicate the manpower deployed category wise daily specifying also the activities in which they are engaged.

3.12.3 The progress reports shall indicate the progress achieved against planned with reasons indicating delays if any and shall give remedial action which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original programme and the slippage do not accumulate and affect the overall programme in a format designed and approved by BHEL site engineer.

3.12.4 The contractor shall arrange for weekly progress review meeting with the "Engineers" at site during which actual progress during the week vis-à-vis scheduled programme shall be discussed for action to be taken for achieving targets. The programme for subsequent work shall also be presented by contractor for discussion. The contractor shall constantly update/revise his work programme to meet the overall requirements and suit the material availability.

3.12.5 The contractor shall arrange for submitting three sets of progress photographs every month to BHEL office the areas to be photographed will be as per the instruction of BHEL Engineer. The quoted rate shall include this contingency.

3.12.6 The contractor must obtain the signature and permission of the security personnel of the customer for bringing any of their materials inside the site premises, without the Entry Gate Pass these materials will not be allowed to be taken outside.

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

3.13.0 SPECIFIC REQUIREMENTS FOR ISO 9001-2000

IMPORTANT NOTE

Contractors shall ensure that all their Staff/Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 - 2000 Standards.

Contractors shall ensure that the Quality is maintained in all the works connected with this contract at all stages of the requirement of BHEL.

Contractor shall ensure that all Inspection, Measuring and Testing equipment that are used, whether owned by the contractors or used on loan, are calibrated by the authorized agencies and the valid calibration certificate will be available with them for verification by BHEL. A list of such instruments possessed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.

Contractors shall arrange for the inspection of the works at various stages as required by BHEL. Immediate corrective action shall be taken by the contractors for the non-conformances if any, observed and pointed out by BHEL.

3.14.0 INSPECTION / QUALITY ASSURANCE / QUALITY CONTROL STATUTORY INSPECTION

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

Preparation of quality assurance log sheets and protocols with customer's Engineers, welding logs and other quality control and quality assurance documentation as per BHEL Engineer's Instructions, is within the scope of work / specification.

The protocols between contractor and customer/BHEL shall be made prior to installation for correctness of foundations, materials, procedures, at each stage of Installation, generally as per the requirement of Customer/BHEL. This is necessary to ensure elimination of errors or keeping them within tolerable limits and to avoid accumulation and multiplication of errors.

A Daily log Book should be maintained by every supervisor/Engineer of contractor on the job in Duplicate (One for BHEL and one for Contractor) for detailing and incorporating Alignment/clearance/centering/Leveling Readings and Inspection details of various Electrical and C & I works.

All the Electrical/Technical Measuring and Testing Instruments/Gauges, Feeler Gauges, Highest Gauges Dial Gauges, Micrometers, Levels Spirit Levels, Surface plates, straight Edges, vernier calipers and all measuring instruments shall be provided by the contractor for checking, leveling, Alignment, Centering etc of Erected Equipments at various stages. The Instruments / gauges / Tools etc. provided should be of Brand, Quality and Accuracy, Specified by BHEL Engineer and should have necessary Calibration and other Certificates as per the Requirements BHEL Engineer.

Total Quality is the Watch Ward of the work and standards, Procedures laid down by BHEL. We shall follow all the Instructions as per BHEL Drawings and Quality / Standards. Contractor shall provide for the services of quality Assurance Engineer.

3.15.0 STAGE INSPECTION BY FES / QA ENGINEERS :

Apart from Day-to-Day Inspection by BHEL Engineers Stationed at site and also by Customer's Engineers, Stage Inspection of Equipment under Erection and commissioning at various stages of Erection and commissioning by TEAMS of Engineers from Field Engineering Services of BHEL's Manufacturing units and Quality Assurance Teams from Field Quality Assurance Unit/ Factory Quality Assurance and commissioning Engineers Contract shall arrange all labour, Tools and Tackles, etc. for such stage inspections free of cost.

Any modifications suggested by FES and QA Engineers Team shall be carried out. Claims of Contractor, if any shall be dealt as applicable.

Any minor rectifications of minor repairs of defective work found out during stage Inspection shall be rectified free of cost, by the contractor.

Any major rectification or major repairs of defective work found out during stage inspection verification / checking but not attributable to contractor shall also be carried out. Claims of contractor, if any, shall be dealt as applicable.

3.16 STATUTORY INSPECTION

3.16.1 The scope includes getting the approvals from the Statutory Authorities like Boiler inspector and Labour officers. This includes arranging for inspection visits of boiler inspector periodically as per BHEL Engineer's instructions, submitting documents, radiographs, etc. and following up the matter with them.

3.16.2 All fees connected with the contractors for testing his welders / men / workers and testing, inspection, calibrating of his instruments and equipments, shall be paid by the contractor. It shall be his responsibility to obtain approval of statutory authorities, wherever applicable, for the conducting of any work which comes under the purview of these authorities. Any cost arising from this shall the contractor's Account. However, BHEL shall pay all other fees (FEES FOR VISITS, INSPECTION FEES, REGISTRATION FEES, ETC.) In case these inspection have to be repeated due to default / fault of the contractor and fees have to be paid again, the contractor shall have to bear the charges. These would be deducted from his bills.

HSE SPECIFIC REQUIREMENT

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM

SUB CONTRACTOR TO ENSURE COMPLIANCE OF THE FOLLOWING **HEALTH** RELATED POINTS

01. Sub-contractor to identify nearest hospital for Health check up of his staff and workers and intimate BHEL site office & PSSR HQ.

02. To arrange for occupational health check up / screening of contractor's staff and workers engaged in sub contracting activities. In this, category of workmen such as welders, gas cutters, grinders, radiographers, crane operators are to be given exclusive attention in respect of health screening.

03. Sub-contractor to arrange an ambulance vehicle or emergency vehicle on a continuous basis to meet any emergency situation arising at site work in which his staff and workers are engaged.

04. To provide appropriate facilities for prompt first aid treatment of injuries and illness at work. One first Aider for each sub contractor to be provided. First Aider should undergo training on first aid.

05. To provide filtered drinking water at selected place in a clean container.

SUB CONTRACTOR TO ENSURE COMPLIANCE OF THE FOLLOWING **SAFETY** RELATED POINTS

01. Personnel protective equipment (PPES): Required number of following PPES (Confirming to Relevant is Standards) to be made available to workmen at site and ensured that they are used .

- Helmet
- Safety goggles
- Welding face shields
- Safety belts for working at heights
- Safety shoes
- Ear plugs
- Rubber gloves and mats for low tension (I.T) electrical works
- Gum boots & aprons
- Other items as required by BHEL site

02. Sub contractor to liaise with nearest fire station and inform contact telephone number and contact person to meet any emergency.

03. To provide appropriate fire fighting equipment at designated work place and to provide fire fighting training to selected persons in his group of workmen to meet emergencies.

04. To provide adequate number of 24 V power supply points to work in a constrained and enclosed space.

05 . All power tapping points / switch boards /power & control cabling should fulfill required electrical safety aspects as per relevant is standard.

06. ELCH's (Earth leak circuit breakers) at all electrical distribution points to be provided.

07. Red and white caution tape of proper width (1.5 to 2 inch) to be used for cordoning unsafe area such as open trench, excavated area, etc.

08. To provide sub-contractors company logo or clothing to all staff and workers for identification including identity cards with photographs approved by BHEL.

09. High pressure and structural welders to be identified with colour clothing and to display copy of welders certificate with photographs of welder at the work place. They also should be in possession of valid welding procedure.

10. To display safe handling procedure for all chemicals such as lube oil, grease, sealing compound, kerosene, diesel etc. At stores & respective work place.

11. Contractor should authorize a person at site to stop work if there is a unsafe work noticed as per his knowledge.

12. Fitness for use of erected scaffolding to be certified by the contractors approved scaffolder and the certificate should be displayed on the scaffolding itself. If the scaffolding is unsafe , the same will not be used. the certificate to be updated daily. The scaffolding to be made as per the relevant is standard.

13. For making platform on the scaffolding , proper thickness and size of the plank of required quality wood to be used. The safe working load of the platform to be displayed on the scaffolding itself. Proper use of platform to be explained to the user.

14. All plant equipment should have inspection report before put in to use.

15. All T&Ps should be of reputed brand and having quality certificates.

16. All IMTEs should have valid calibration certificate from recommended institution / testing lab and these should be in place.

17. All lifting tackle and plant equipment should have safe working load certificate.

18. The right worker should be deployed for right job and the resume of site in charge, supervisors, and key workers to be submitted before commencement of work..

19. Sub-contractor should submit inspection / testing matrix of all T&Ps and to be approved by BHEL.

20. Sub-contractor to display safety slogan, safety board, caution boards wherever required in consultation with BHEL.

21. Sub-contractor to provide gas detectors of reputed make at desired locations.

22. Sub-contractor to conduct emergency mock drills. one drill per 6 month and submit report to BHEL.

23. Safe handling and storing of all equipment with adequate space to be ensured.

24. Sub contractor to deploy safety supervisor till the completion of the project.

25. Sub contractor to comply the safety reporting procedure of BHEL as practiced at present and also additional requirements that may arise out of future improvements in the safety management system. This includes computation of safety indices such as frequency rate, severity rate & incident rate.

26. Sub contractor to identify probable emergency situations such as elcetric shocks to workmen , caving in of shored earth , fall from height, collapse of scaffolding fire etc., and should have clear action plan to overcome them. Sub contractor to take required guidance from BHEL in this regard.

27. Sub contractor to identify hazardous activities which he may carryout and should train his workmen in those activities with the relevant operation control procedures. Sub contractor to take required guidance from BHEL in this regard.

28. Safe work permit system to be followed while working in confined space / near electric systems.

SUB CONTRACTOR TO ENSURE COMPLIANCE OF THE FOLLOWING **ENVIRONMENT** RELATED POINTS

1. HOUSE KEEPING : Sub contractor to carry out daily house keeping of work areas / stores through a check list prepared in consultation with BHEL.

2. Sub contractor shall adopt pollution prevention / reduce /control approach in all his site activities. this shall include:

    a. Transporting of oil / chemicals from stores to site safely without causing spillage. in case of any spillage, the area shall be cleaned and the remanant spilled oil disposed off to a safe place, identified for such disposal.

    b. To use required containers / cans / safety gadgets /appliances for transporting and for usage of oil / chemicals at site.

3. Sub contractor shall arrange for segregation / collection of scraps and dispose off to the identified place meant for scrap collection.

4. Sub contractor to adopt good erection practices / procedures with the objective of reduction of waste generation / rework

OTHER HSE REQUIREMENTS TO BE COMPLIED BY SUB CONTRACTOR

1. Sub contractor to clearly understand and accept the HSE policy of PSSR with a commitment to comply the requirements of the policy.

2. Sub contractors to arrange for daily meeting of their supervisors and work force before they disperse for their daily planned activities where in the relevant health , safety and environment aspects of the job and use of PPES are explained

3. Sub contractor to conduct monthly HSE meeting (internal) and submit the report to BHEL.

4. HSE slogans to be displayed in a proper board – hoarding at designated places in consultation with BHEL.

5. Sub contractor to submit a structured programme for training & occupational Health Screening of their work force at site after the Award of LOI.

SECTION VI

RAYALASEEMA TPS UNITS 3& 4 (2X210 MW)

ELECTRICAL PACKAGE

SCOPE OF WORK AND SPECIAL CONDITIONS

6.1.0 General

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

Identification of equipment at storage yard, technical assistance for checking and making the shortage / damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erection, checking, carrying out statutory tests as required, pre-commissioning, commissioning & post-commissioning activities and maintenance up to the time of efficient highly reliable commercial & trail operation of the unit and handing over to customer or till completion contract period which ever is earlier, along with the supply of all consumables, tools and tackles and testing instruments. The installation and commissioning of all the electrical equipments / items shall conform to the technical requirements specified in separate sections of the tender.

6.1.1 The performance of the Contractor's works under the Contract shall be in accordance with good engineering and construction practices, notwithstanding the fact that every item involved may not be specifically mentioned but necessary to complete the system shall be deemed to have been included in the scope of the work to meet the Main plant requirement.

6.1.2 Site testing wherever required shall be carried out for all items installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.

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

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

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

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

6.1.7 All necessary certificates and licenses required to carryout this work are to be arranges by the contractor expeditiously at his cost.

6.1.8 During the course of erection, testing and commissioning of electrical work, certain rework / modification / rectification / repairs /fabrication etc. May be necessary on account of feed back from other power statins or units already commissioned and / or units under erection and commissioned and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously.

6.1.9 The contractor shall take delivery of item, materials, from the storage yard / stores / sheds of BHEL / customer which is within a radius of 5 kms. Contractor shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to him till they are fully, erected, tested and commissioned.

6.1.10 Contractor shall transport the materials to erection site by the prescribed route without disturbing and causing damage to other works in the most professional manner. Items, Hardware, etc. shall be stored in appropriate manner as per BHEL's instructions.

6.1.11 The contractor shall take delivery of / materials, and consumables from the stores / storage area / sheds of BHEL / customer after getting approval of engineer / customer in the prescribed indent forms of BHEL / customer.

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

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

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

6.1.15 Contractor shall remove all scrap materials periodically generated from his working area in and around power station and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and removed the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc,. shall be returned to the BHEL stores / customer's stores by the contractor.

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

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

6.1.18 The Contractor may have to execute work in such a place and condition where other agencies also shall be under such circumstances. However completion time for erection agreed shall be subject to the condition that contractor's work is not hampered by the agencies.

6.1.19 Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above

scope of works. The contractor shall have valid **ELECTRICAL CONTRACTOR LICENSE** to carry out the Electrical works.

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

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

6.1.22 If any item or equipment not covered but required being erected / commissioned, the same shall be carried out by the contractor. Equivalent unit rate for those items or equipment shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

6.2.0 SCOPE OF WORK IN GENERAL

Scope of Electrical works covered in this tender are as follows :

6.2.1 Erection and commissioning of all types of Transformers.

6.2.2 Erection and commissioning of HT Switchgears, LT MCC, AC/DC Distribution Boards Starter Panels, Excitation Panels, Control Panels etc.

6.2.3 Erection and commissioning of HT Bus Ducts (IP & SP)

6.2.4 Erection and commissioning of Generator and Transformer protection Panels, DAVR and other Electrical protection and control panels

6.2.5 Erection of Trays & accessories and Trays supports.

6.2.6 Erection and commissioning of VFD systems,.

6.2.7 Erection and commissioning of Battery Charger panels,.

6.2.8 Installation of push button stations for local starting of all motors, junction Boxes etc.

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

6.2.10 Laying and termination of HT / LT cables,

6.2.11 Installation of cables, glands and lugs of 2.5 sq.mm and below ferrules, tag plates, and cable dressing materials.

6.2.12 Installation of above ground earthing grid, equipment earthing of all equipment, cable racks, trays etc and test pits,

6.2.13 Installation of Lightning protection

6.2.14 Installation of items for underground cable installation like cable markers, cable joint markers etc (if applicable)

6.2.15 Installation of rubber rubber floor mats for LT Panels,

6.2.16 Supply of all consumables required for installation. As detailed elsewhere in the contract.

6.2.17 Commissioning of HT/LT- drives, MOVs and electrically operated equipment erected by Mechanical contractor.

6.2.18 Supply and painting of all steel fabricated items.

6.2.19 Excavation of earth in any type of soil and refilling earth.

6.2.20 Supply of river bed sand and spreading

6.2.21 Erection of RCC Home Pipes

6.2.22 Supply of standard Bricks and spreading

6.2.23 The scope of work in general covers identification of times at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, checking, erection, testing and commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plats, ferrules, lugs, (specific sizes), specific type of fasteners / supervisors, T & P, Material handling equipments, testing instruments (excepting proprietary type instruments) returning of un-used materials / items of BHEL stores.

The detailed scope of work equipment- wise is as follows.

6.3.0 DETAILED SCOPE OF WORK

6.3.1 TRANSFORMERS

6.3.1.1 Scope of Supply and Specification of Transformers

Different types of transformers like oil immersed or dry type shall be supplied as indicated below and shall be suitable for outdoor installation. Generator transformer, unit transformer, station transformer and unit auxiliary transformer shall be located adjacent to the powerhouse building in the transformer yard. Oil filled station service transformer shall be located adjacent to the respective service building. The dry type service transformer shall be installed inside MCC room.

A) 240 MVA GENERATOR TRANFORMER :

Description : The Generator Transformer shall be of 240 MVA, 15.75/236kV, three phase, OFAF cooled, Ynd1, with loose accessories like 2 Nos. of Radiator banks, on load tap changers, HV/LV/HVN bushings, bushing CTs, Turrets, conservators, cooler control cabinet, marshalling box, pipings, common KIOOSK etc. Loose items raise / lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps.

Accessories : PRV –1, Drain valve 2, Cooler control cabinet-1, inlet-2 & out let valves –1 (1 each), 36kv 22kV post insulator –3 4, 17.5 kv, 1000A bushing – 2 (HT bushing – 3)

Conservator : Main conservator tank with air cell, bucholz relay, breather & connected pipelines.

Cooling system : Radiator assembly –24, Header –4, A frame support – 4, Fan motor – 10, Oilpump-4, Turrent and bushing ; HV line 3 & neutral bushing 1 each LV bushing –3, HV turret 3, LV turret – 1, valves and fittings as per drg no 3 459 00 00241

Approximate dimensions of each transformer : (l x b x h)

Shipping dimensions : 7900 x 3400 x 3800 mm
Overall dimensions : 15430 x 8430 x 7420 mm

Approximate weight of transformer Components

Core & Winging	:	132000 Kg
Oil	:	48700 Kg

Total Weight : 248000 Kg

Shipping weight : 156000 Kg

Total Oil Quantity : 56000 Ltrs

Ref : 3 459 0000 240 (3sh) / rev 02, 3 456 0000 242

QUANTITY : 2 Nos.

B) 31.5 MVA STATION TRANSFORMER

Description : Station shall be of 31.5 MVA, 220/ 7.1 KV 3 Phase, Yndl ONAF station Transformer with OLTC on HV side +7.5% to –12.5% in steps of (1.25%) 2.5 in non auto mode, with bushing CTs radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc.

Loose items : Like raise / lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. Shall be mounted and wired in control panel

Accessories : PRV –1, Drain valve 2, Cooler control cabinet – 1, inlet & outlet valves (1 each) etc.

Conservator : Main conservator tank, Buchloz relay, breather & connected pipelines.

Cooling system : Radiator assembly-11, Header – 2, Aframe support – 2,. Pan motor –11

Turret and bushing : HV turret 3. LV turret 1, HV line –3& Neutral bushing 1, LV bushing (3) 6, on load tap changer drive – 1 set

Approximate Dimensions (mm):

a. Overall Dimensions	10000 x 5130 x 7115
b. Shipping Dimensions	5160 x 2600 x 3600
c. Height for untanking	8900

Weight of Transformer Components (Kg) :

a. Core & Winding	30000
b. Tank, Fittings	16535
c. Oil (26400 Litres)	22970
d. Untanking weight	30000

e. Total weight 78000
f. Shipping weight(gas Filled) 45800
Ref. Drg : 3458 0000 198 (4sh), 3458 0000 199, 3458 0000 200

QUANTITY : 1 No.

C) 16 MVA UAT TRANSFOMER (3A & 3B, 4A & AB)

Description : UAT shall be of 16 MVA 15.75 / 6.9 kV, 3 Phase, ONAF, Dd0, with OLTC on HV Side. With bushing CTs radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc.

Loose items : Like raise / lower P.Bs tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. will be supplied loose, to be mounted and wired in control panel.

Accessories : PRV-a, drain valve 2, Cooler control cabinet-1, inlet & outlet valves (1 each), HVLV post insulator – 4

Conservator : Main conservator tank, Bucholz relay, breather & connected pipelines

Cooling system : Radiator- 6, radiator tie bar – 10, Fan motor –6

Turret and bushing : HV line – 3 & HV busduct-3, LV bushing –3, & LV bus duct –1
On load tap changer – 1 set (as per drg 24560050 328)

Approximate Dimensions : (mm)

a. Overall Dimensions 6200 x 5400 x 4900

b. Shipping Dimensions 5400 x 2700 x 2800

Weight of Transformer Components (Kg) :

a. Core & Winding 16000
b. Tank, Fittings 14000
c. Oil (26400 Litres) 10200
d. Untanking weight 16000
e. Total weight 40000
f. Shipping weight(gas Filled) 24000
g. Total Oil Quantity(Litres) 11000

Ref. Drg : 2 456 00 50 328 rev 02, 2 456 00 50 329 rev 01 and 1 456 00 50 328 rev 02 2 456 19 50 264.

QUANTITY : 4 No.

D) 2500 KVA UNIT SERVICE TRANSFORMER (-3A & 3B, 4A&4B)

Description : 2500 KVA, 606 KV/433 V, AN, 3 Phase 50Hz Dyn 11, Dy type cast resin Transformer, HV busings rated for 12 kV, Marshalling Box, HV Cable Box, LV Bus duct connections, other accessories etc.

Approximate Dimensions

Overall dimensions : 3000 x 2065 x 2900mm

Weight of transformer components

Core coil assembly	7500 Kg
Enclosure	800 Kg
Total Shipping	8300 Kg
Quantity	4 Nos

E) 2500 KVA STATION SERVICE TRANSFORMER (-CWT2A&2B, CLWT 2A&2B)

Description : 2000 KVA, 6.6KV/433 V, AN, 3 Phase, 50 Hz Dyn 11, Dry type cast resin transformer, HV bushing rated for 12 kV , Marshalling Box, HV Cable Box, LV Bus duct connections, other accessories etc.

Approximate Dimensions

Overall dimensions : 2800 x 2065 x 2750mm

Weight of transformer components

Core coil assembly	6200 Kg
Enclosure	800 Kg
Total Shipping	7000 Kg
Quantity	4 Nos

F) 1600 KVA UNIT SERVICE TRANSFORMER (UST3A(B), 3B(B) & 4B (B), SST 2A, 2B, 2C, 2D, ACT –2A,2B)

Description : 1600 KVA, 6.6KV/433 V, AN, 3 Phase, 50 Hz Dyn 11, Dry type cast resin transformer, HV bushing rated for 12 kV , Marshalling Box, HV Cable Box, LV Bus duct connections, other accessories etc.

Approximate Dimensions

Overall dimensions : 2800 x 2065 x 2750mm

Weight of transformer components

Core coil assembly	5800 Kg
Enclosure	800 Kg
Total Shipping Weight	6600 Kg

QUANTITY – 10 Nos

G) 1000 KVA STATION SERVICE TRANSFORMR (UST3A(T), 3B(T) & 4B (T), DMCWT 2A, 2B)

Description : 1000 KVA, 6.6KV/433 V, AN, 3 Phase, 50 Hz Dyn 11, Dry type cast resin transformer, HV bushing rated for 12 kV , Marshalling Box, HV Cable Box, LV Bus duct connections, other accessories etc.

Approximate Dimensions

Overall dimensions : 2200 x 1665 x 2500mm

Weight of transformer components

Core coil assembly	3650 Kg
Enclosure	600 Kg
Total Shipping Weight	4200 Kg

QUANTITY – 6 Nos

H) VFD TRANSFORMER

1600 KVA, 6.6/1.25 KV, 3f, ONAN, Dd0/Dyn11, dry type cast resin type transformer with HV, LV cable boxes, etc.

Approximate dimensions

Overall dimensions : 3000 x 2200 x 2665 mm

Weight of Transformer Components

Core Coil Assembly	5600 Kg
Enclosure	900 Kg
Total Shipping weight	6500 Kg

QUANTITY – 8 Nos

I) COMMISSIONING OF HIGH VOLTAGE RECTIFIER TRANSFORMER

Commissioning of High voltage rectifier transformer – 95kv, 800mA

The scope of work includes oil filtration, sample testing for dielectric strength, PPM etc., calibration of WTI, Bucholz relay etc.

Approximate Oil Quantity per transformer : 500 litres

J) NEUTRAL GROUNDING RESISTOR

Neutral Grounding Resistor (NGR), Indoor Type, 1100V, 1 A, 350 ohms, with mounting and connected accessories

Size : 450 x 325 x 820 mm; Weight: 45 kg

Reference drawing : A3-1764/Rev 1 (Sheets 1-4)

6.3.1.2 Scope of work of Transformer

1. Receipt of all accessories & Spares including oil in drums from site store/yard, inspection, handling of accessories between stores & transformer yard / location up to respective plinth, storage, maintenance of N2 gas pressure in transformer tank, erection of all the accessories including NGR, cabling from transformer accessories, to marshalling KIOSK & OLTC panel, oil filling, oil pressure testing dry out, pre-

commissioning test, commissioning of equipment and final painting and handing over.

2. Generator, Station and UAT Transformers that are to be mounted adjacent to PH building shall be made available near at in the unloading bay. The contractor shall make arrangements for shifting to the location. The contractor shall unload the transformers on rails, turn the wheels/rollers if necessary for changing over at right angles on rails, roll the transformers to their respective locations and put them on the foundation. The necessary sleepers, winches, jacks etc. required for this operation shall be arranged by the contractor at his cost. All other transformers shall be shifted with suitable material handling equipment to the respective location.

3. Generator, Station and UAT Transformer shall be dispatched to site in several packages which shall be assembled / erected at site.

4. **Station service, Unit service and VFD transformers are of dry type and mostly dispatched in assembled or semi assembled condition. Contractor shall arrange to assemble at site and carry out testing as mentioned above. These transformer shall be installed in closed areas like Electrical / switchgear rooms and other auxiliary buildings.**

5. Samples of each and every drum of Transformer oil have to be tested and pre-treated to achieve the desired value before filling into the transformer tank. The entire arrangement for testing the oil sample, filtering whenever required to achieve the desired PPM, BDV within the shortest time shall be made by the contractor. The job has to be taken up in consultation with BHEL Engineers at site at the cost of the contractor. All the test equipment for testing specific gravity, PPM, BDV of the oil including testing equipment required for the Tan-Delta Test of the transformer winding and HV Bushing shall be arranged by the contractor. Testing instruments required for DEW measurement of N2 gas shall also be arranged by the contractor.

6. All the T & P material handling equipment like cranes, Trailer, required Nos of High Vac filter machines with adequate capacity, vacuum pumps and 5 kV motorized megger and oil tank of suitable capacity shall be arranged by the contractor at his cost. The transformers may have to be suitably lagged / covered during the drying out operation by the contractor at no extra cost.

7. The contractor shall engage his men on three-shift operation during drying out he transformers.

8. Auxiliary / Service transformers shall be bolted to the adopter panel / bus on both the sides and the busbars shall be connected together The contractor at no extra cost shall carry out any modifications required in the bus connectors for matching the PCC Busbar with the transformers LT side.

9. Erection of adopter panel (LT non segregated busduct) that shall be supplied along with PCC is also part of Transformer erection.

10. The auxiliaries components of the above transformers are to be cleaned and checked before the assembly as instructed by BHEL Engineer.

11. **The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams and should not engage outside agency for testing, Testing shall be done under the supervision of BHEL / customer Engineers.**

12. Test value of dielectric strength / PPM, specific gravity and Tan-Delta test shall be as per recommended value of BHEL. If the test results are not satisfactory and if the customer desires to carry out the tests through some other agency, the same shall be carried out at contractor's cost.

13. All the transformers protective system such as Buchholz relay explosion vent, oil and winding temperature detectors etc., healthiness are to be checked under the guidance of BHEL Engineer.

14. Transformer protective relays are to be checked prior to the commissioning of the transformer.

15. The scope of erection work shall also include minor civil work such as shipping and grouting of the support structure as well as for the support of the transformer.

16. Final painting shall be carried out for all the oil filled Transformers. The scope of final painting involves supply of paints, thinner and other consumables, at the cost of the contractor as detailed in the painting clause. No separate rate shall be paid for painting.

17. During the oil circulation of the transformer, the contractor has to employ sufficient number of personnel who shall take care of the operation of the operation of the filter machine as well as safety of the transformer.

18. Calibration of Testing equipment : all testing equipment (IMTE) shall be calibrated before putting into service at site. A copy of calibration certificate to be this effect shall be furnished to BHEL – Engineer for his verification and approval.

19. The contractor shall prepare all log sheets, test certificates, protocols etc. as per field quality plan, get it signed by concerned BHEL /CUSTOMER Engineer and submit to the concerned BHEL Engineer.

20. Preservative gas like N_2 shall be supplied by BHEL free of cost to maintain the N_2 pressure during preservation

21. The contractor shall maintain the equipment erected and commissioned by him until taken over by CUSTOMER or up to the contract period.

22. BHEL will provide 75/18 Ton capacity cranes for the purpose of erection of transformer assembly on sharing basis at free of cost. However, the contractor shall arrange operator, fuel and other consumables.

23. The contractor shall arrange minimum one No. 6000 litre / hour and one No. 4500 litre / hour filtering machines, for power transformer. The contractor has also to arrange one no. 1000 LPH filtering machine for ESP Transformer.

24. All the free issue equipments shall be returned to BHEL in good condition and any defects noticed at the time of handing over shall be rectified by the contractor.

25. The contractor shall prepare all erection / commissioning log sheets, protocols / test certificates as per field quality plan, get it signed by the concerned BHEL / CUSTOMER Engineer and submit the same to BHEL: Engineer as per his instruction.

6.3.2 6.6 / 3.3 KV HT SWITCHGEAR AND GENERTOR AND TRANSFORMER RELAY & PROTECTION AND DAVR PANELS :

6.3.2.1 General construction and operation features of HT Switchgear :

HT switchgears supplied shall be 6.6 & 3.3 KV. HT Switchgear shall be installed at 3.5 Mtr level in PH building, VFD electrical rooms.

6.6 KV HT Switchgear shall be installed at HT Electrical room at 5 Mtrs level in PH building. The HT switchgears shall be of Type VM12 metal clad switchgear is of horizontal draw out pattern, suitable for easy extension of switchboard on both directions for system sup to 12 KV. The design incorporates single busbar system and a set of interlocks for safety of operations and is fully compartmentalized. A panel consists of a fixed portion (and a moving portion) of modular construction having three high

voltage chambers namely breaker chamber, busbar chamber and CT chamber. Instruments panel is a separate low voltage chamber and shall be supplied with different type of protection relays, instruments like Meters, Transducers, etc. Moving portion comprises of wheel-mounted truck fitted with an operating mechanism, vacuum interrupters & isolating contacts. Generator relay and control panels shall be supplied with different type of protection relays, instruments like Meters, Transducers, etc and these panels shall be mounted at unit control room.

Motor operated spring closing mechanism keeps the springs charges after every closing operation making it ready for next enclosure. Springs can also be charged manually in case of failure of auxiliary power of the spring charging motor.

Generator & Transformer protection and relay panels shall be supplied with different type of protection relays, instruments like Meters, Transducers, etc and these panels shall be mounted at unit control room.

6.3.2.2. **Detailed specification of Switchgear**

Details of equipment

System Nominal	:	6.6 KV, 3 Phase, 50 Hz
System Voltage Highest	:	12 KV
Neutral	:	Resistance Earthed
Insulation level	:	12 KV / 28 KV/75 KVP
Breaking Capacity	:	40 KA At 12 KV
Making Capacity	:	100 KAP
STC	:	40 KA FOR 1 SEC
Top busbar	:	2750 A
Finish	:	Exterior, Interior & Truck : Synthetic Enamel Smoke Grey to Shade 692 of IS-5.

The switchboards are divided into various sections and the details are as given below.

	HT	DESC	QUANTITY	DIMENSION OF EACH PACKAE IN MM	WEIGHT OF EACH PACKAGE
1	6.6KV	Unit 4 Turbine Switchboard 4CA	11 Panels	820(w) x2700(h) x2360 (d) max.	1500 kg / Panel
2	6.6KV	Unit 3 Switchboard 3CB	10 panels	- do -	1500 kg / Panel
3	6.6KV	Unit 4 Turbine Switchboard 4CB	10 Panels	820(w)x2700(h)x2360 (d) max.	- do –
4	6.6KV	Station Switchboard 0CC	6 Panels	820(w)x2700(h) x2360 (d) max	- do-
5	6.6KV	Station Switchboard 0CC	15 Panels	820(w)x2700(h) x2360 (d) max	- do-
6	6.6KV	Unit 3 Boiler Switchboard 3CC	17 Panels	820(w)x2700(h) x2360 (d) max	- do-
7	6.6KV	Unit 4 Boiler Switchboard 4CC	17 Panels	820x2700 x2960	1300KG/PANEL
8	3.3KV	Unit 3 Boiler Switchboard 3CD	16 Panels	820(w)x2700(h) x2360 (d) max	1500 Kg / Panel
9	3.3KV	Unit 4 Boiler Switchboard 3CD	16 Panels	820(w)x2700(h) x2360 (d) max	- do-
10	3.3KV	CW Pump House Switchboard 0CE	15 Panels	820(w)x2700(h) x2360 (d) max	- do-
11	3.3KV	CW Pump House Switchboard 0CF	15 Panels	820(w)x2700(h) x2360 (d) max	- do-
12	3.3KV	VFD Switchboard Switchboard 0CF	8 Panels	820(w)x2300(h) x2360 (d) max	- do-
13		Earhing trucks breakers	12 Panels	950(w)x1250(h) x1300 (d) max	900kg/panel

6.3.2.2 Scope of work of HT Switchboard, Generator, Transformer, Bus transfer control & relay and DAVR panels :

1. Receipt of all panels, accessories & Spares including rubber mats from site store/yard, inspection, handling of accessories between stores erection location, storage, erection of all the accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and handing over.

2. The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. Wherever the base channels are not available, the same shall be fabricated, erected and painted at no extra cost. The material for this shall be supplied by BHEL. Base channels shall be grouted on the opening of the floor. All minor concrete chipping and finishing works are deemed to be included in the scope of the job including supply of grouting bolts required for the panel, at free of cost.

3. For the panels to be mounted on the trenches, channel supports shall be provide across the cable trenches over which the base frames of the panels shall be mounted Support structure if required shall be fabricated and separate rate on Tonnage basis shall be paid for the fabrication.

4. Panels shall ;be delivered in different shipping sections. Necessary interconnection of busbar, inter panel wiring etc., shall be carried out as part of panel erection after the panel erection.

5. Generally the panels shall be supplied with complete Relays / Instruments and other Components mounted and wired. However, any minor modifications like dismantling of the existing Relays / Instruments / Components and mounting of new Relays / instruments / components and rewiring to suit operating conditions, shall be carried out without any extra cost. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra works basis. Similarly if any Relays / Instruments / Component supplied as loose for safety transit, same shall be mounted and wired as per site requirement at free of cost as part of scope of the job. However, if the loose supplied Relays / Instruments / Components are more than 10% of the total quantity, the same shall be carried out a extra works basis. Decision of site engineer shall be final regarding such extra works.

6. The commissioning of HT Switchgear shall also involve the trial runs and commissioning of all connected equipment like motors and Service Transformer. The contractor shall 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 erected by him. (separate rate shall be paid for commissioning of associated electrical drives as per BOM)

7. The contractor shall do touch up painting of switchgear panels wherever necessary. This includes supply of paint also.

8. All T&P, Material handling equipment including cranes, Relay Testing / HV Testing / Calibration instruments, primary / secondary injection kits, CRO, frequency counter etc. shall be arranged by the contractor,

9. BHEL shall provide EOT cranes for the purpose of shifting the panels with in the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P.

10. The contractor shall calibrate and commission all switchgear / panel mounted instruments, protection relays, transducers, Recorders, indicators, energy meters etc,

11. BHEL shall provide vendor's supports for proprietary type of microprocessor based instruments and Numerical relays which requires software loading and programmer etc. However overall responsibility lies with contractor and the contractor shall provide all supports like manpower, standard T&P, Instruments etc for calibration and commissioning of above proprietary type instruments.

12. The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams and should not engage outside agency for testing. Testing shall be done under the supervision of BHEL / CUSTOMER Engineers.

13. All testing Instruments / Equipment deployed to site shall be calibrated before putting it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for his verification and approval.

14. Switchboards incomer bus shall be connected to SP bus ducts, through adapter box. The contractor shall co-ordinate for proper busbar connection. Any modification required in the bus conductor for matching SP busduct busbar, the same shall be carried out without extra cost.

15. The contractor shall co-ordinate with cable jointer and other LT cable – laying agency for proper cable termination and also during HP testing of cable.

16. All testing Instruments / Equipment deployed at site shall be calibrated before putting it into service. A copy of calibration certificate shall be submitted to BHEL engineer for his verification and approval.

17. Contractor shall prepare all erection / commissioning log sheets, protocols / test certificates as per field quality plan, get it signed by the concerned BHEL/CUSTOMER Engineer and submit the same to BHEL Engineer as per his instruction.

18. The charged and commissioned equipment shall be maintained by the contractor till the same is taken over by M/s. CUSTOMER or up to the contract periods.

19. Any items like lamps, lens, fuse /relays/ instruments missed form the custody if the contractor shall be replaced by the contractor at free of cost.

20. Contractor shall arrange watch and ward for the equipment under his custody and erected in location against theft and damage by other agencies working on the same area.

21. If any removal / Re-fixing of contactors / relays becomes necessary for the completion of the system, the same shall be done by the contractor at free of cost.

22. Rubber mats for switchgear shall be supplied by BHEL, and these shall be laid, wherever required as part of panel erection,

23. Contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer at free of cost as part of panel erection.

24. Scope of work shall also cover drilling of bottom gland plates for cable entry as required.

6.3.3. LT SWITCHGEAR 415V – POWER MOTOR CONTROL CENTERS /MCC /DC /AC / DISTRIBUTION BOARDS :

1. LT MCCs are simple module type with isolators and fuses. However, some of the MCCs are Double Front draw out type consisting of circuit breakers unit, contactors /starter fuse switch units, MCB etc, arranged in multi-tier construction. These MCCs and AC/DC DBs are mainly supplied to cater the requirement of drives, valves, etc. All the LT Switchgear, AC/DC DB shall be located in Level at BC Bay of Power House.

2. AC/DC Distribution Boards are single front non-draw out type, consisting of circuit breaker, contactors, fuse unit, MCB etc. arranged in multi-tier construction, shall be located in MCC room to cater the power supply requirement of Boiler.

3. Scope of work for LT Switchboard and AC/DC DB

   The scope of works shall be similar to HT switchgear (Clause 6.3.2.3). However the following point specific to Lt switchgears are to be considered.

   a. The commissioning of LT Switchgear shall also involve the trial runs and commissioning of all connected equipment like servomotors and drives etc. The contractor will have to keep his people found the clock, if necessary during the trial in the equipment erected by him. (Separate rate shall be paid for commissioning of associated electrical drives as per BOM)

   b. MCC incorner bus shall be connected to PCC of customer. The contractor shall co-ordinate for proper connection at PCC.

   c. Dimension & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Variations in depth, height o weight of the panel shall not be considered for payment.

   d. Any variation in length within +/- 20% shall not be considered for payment.

   e. If the panels supplied at site have any variation in length beyond +/- 20% as compared to actual length indicated in the BOQ, Payment shall be considered proportional to the length of the panel only.

   f. Erection of Residence box of DC drives shall be part of DC starter panels.

6.3.3 DUSDUCTS

6.3.4.1 BUS DUCT DETAILS

Two types of bus ducts shall be supplied for this project as detailed below.

a) HT isolated Phase Busducts from Generator to Generator Transformer

b) HT Segregated Phase Busduct between unit Aux Transformers and 6.6 & 3.3 KV Switchboards, between Station Trasnformer 6.6 KV Switchboards and associated interconnection / Tie Bus ducts etc.

6.3.4.2 **Isolated Phase Busducts**

The isolated phase busducts is connected to the low voltage side of the generator transformer and generator. The bus consists of cylindrical/octagonal conductor made of Aluminium alloy supported on post insulators. Flexible connections and expansions joints are provided at terminal and intermediate points to alleviate stresses due to expansion and to arrest vibration. All the CTs shall be mounted inside the busducts.

Isolated phase taps connect the potential transformer, surge protection equipment and unit transformer to the main bus. Each phase of protection equipment and potential transformer shall be housed in meal clad cubicles. Delta formation is carried out externally through Delta busduct.

A totally enclosed neutral grounding cubicle is provided to connect the Generator neutral point. The neutral grounding cubicle shall be at 0 M level which houses neutral grounding transformer & resistor. All the generator-isolated busducts are supplied with one set of Air pressurization equipment unit.

The Tentative details are as under:

1. Rated working voltage at 50 Hz 15.75 KV

2. Highest system voltage 17.5 KV

3. Basic impulse level 125 KV PEAK (1.2/50 micro –sec wave)

4. Short time current rating(rms) 70 KA for 1 Sec. (Main Run)
120 KA for 1 Sec. (Tap-off Run)

5. Continuous current rating within busduct under the site conditions	10000 A (Main Run), 1500 A (Tap – off Run)
6. Busbar	
a) Material and grade	Al Alloy
i) Main Run	Gr-19501
ii) Tap off Run	Gr-63401
b) Shape & size	
i) Main run	Round 465 O/D, 15 tk
ii) Tap off Run	Tubular 114.3 O/D, 8.56 thick,
7. Enclosure	
a) Material	Al Alloy
i) Main Run	Gr 19500
ii) Tap off Run	Gr 31000
b) Shape	Round
c) Size :-	
i) Main Run	1000 O/D, 6.35 tk
ii) Tap Off Run	680 O/D, 4.78 tk
8. Type of cooling	Air Natural
9. Type of busbar joints	Bolted (silver plated) / Welded
10. Applicable standard	IS : 8084
11. Degree of protection	Air and water tightness as per Appendix 'F' of IS : 8084
12. Neutral grounding transformer	
i) Type	Epoxy cast Resin dry type
ii) Transformer Rating	

Primary Voltage	15.75 KV
Secondary Voltage	240 V
Phase	Single

13. Neutral grounding resistor

a) Type	S.S. Punched Grid Type
b) Voltage	240
c) Resistance	0.3519 Ohms with taps at 0.2114, 0.2639 & 0.2991 Ohms.

14. Hot air blowing equipment (HAB)

For each unit Each set of HAB equipment consisting of following equipment shall be supplied with the system: Centrifugal Fan., Drive Motor Filter Set, Heater, Thermostat, Air stat, Flexible Duct. Hot air Blower equipment shall be supplied complete with control station, blower, and drying, flexible hose, with IP 52 protection.

Hot Air Blower: 6000 Cum /hour, sizze 1500 x 1200x 15000mm, weight 1 ton approx.

15. Erection Details of Busducts:

Sl.No.	Description	Qty. / Wt.
1	Main IPB	
	a. No. of ducts (Approx.)	32 Nos.
	b. Weight of each duct (Approx.)	750 kg (max.) / 600kg (average)
2.	Tap – off IPB	
	a. No. of ducts (Approx)	18 Nos,
	b. Weight of each duct (Approx)	180 kg

3. Hoods for GT / UAT/ LAVT / NG

a. No. of Hoods	11 Nos.
b. Weight of each hood (Approx)	180 kg

4. Hoods for GT/UAT/LAVT/NG

a. No. of Hoods	11 Nos.,
b. Weight of each hood (Approx)	100 kg

5. Star duct

a. Quantity	1 No.
b. Weight (Approx)	800 kg

6. Main Chamber

a. Quantity	1 No.
b. Weight (Approx)	5000 kg

7. Other Details of Busduct

a. No. of Welded Joints in main duct (Approx)	31 Nos.
b. No. of Flexible Conn. Joints incl. Terminations (Approx)	19 Nos
c. No. of Rubber Bellows (Approx)	19 Nos.
d. Total length of Main IPB including Neutral duct 50m Approx.	50x3=150m single phase length
e. Total length of Tap-Off IPB : 20m Approx	20x3=60 single phase length

16. Shorting Bars

One set of shorting bar common for both the sets shall be supplied for generator dryout.

17. LA & VT Cubicle

LA & VT Cubicle shall be of draw out type with VT mounted on trolleys, fabricated out of 3 mm thick steel sheet, complete with illuminating lamps, space heater, busbars, mounting insulators, marshalling box, etc. The cubicle shall be self-supporting type. Each set shall comprise of the following :

i. Single phase epoxy cast dry VT 09 Nos.

ii. Lightning Arestor (KV, KA) 03 Nos

iii. Surge Capacitor (28 KV, 0.125 micro Farad) 03 Nos.

iv. Weight of the cubicle 4500 kg

v. LAVT Cubicle : 3 Nos. each of size 800 x 2050 x 2400 mm weight 1500 kg

vi. Degree of protection IP54

18. NG Cubicle

NG Cubicle shall be fabricated out of 3 mm thick steel sheet complete with illuminating lamps, space heater, busbars, mounting insulators, marshalling box, etc. The Cubicle shall be self-supporting type and degree of protection shall be IP54/P23 shall house the following :

i. Dry type epoxy cast NG transformer 1 No.
(75 KVA (cont), 21 KV/220 V; 1 Ø Class of Insulation : B)

ii NG Resistor (220 V, 1000 A (for 5 min.) 0.167 ohms)

iii. NG Cubicle : 2000 x 1250 x 1300 mm; 1500 kg approx.

19. Busduct Supporting Structure.

Busduct supporting structure shall be fabricated from standard steel sections welded / bolted and hot dip galvanized, All structure hardware shall be HTS hot dipped / electro-galvanized.

Wight of structure : 14 MT

6.3.4.3 Segregated Phase HT Busducts

A) General Description

6.6 KV Segregated phase busduct shall be supplied complete with AL alloy enclosure and onductor, Al Alloy barier, single porcelain bus support insulator arrangement, rubber bellows, inspection windows etc. All bolted joints shall have high tensile steel hardware which shall be cadmium plated / zinc plated and passivated. All conductor bolted joints shall be silver plated SP Bus ducts shall be connected to LT side if, UAT, Station Transformer, Switchboards of KV and associated interconnection / Tie Bus ducts etc.

1. Total Length of SP Busduct shall be approximate 825 mtrs

2. Size of Busduct : Dimension : 450x1350 mm size rectangular box enclosure.

3. Weight of Busduct :

a) Busduct between Station Transformer and Switch Board = 600 x 1600mm size rectangular box enclosure Wt. 100 kg / mtr.

b) Busduct between SWBD OCC-1 and SEBD SA of Stage –1 =450x1600mm size rectangular box enclosure wt. 85 kg / mtr.

c) Balance all busduct sections =450x1350 mm size rectangular enclosure wt. 75kg / mtr.

4. There are no CT's in the busduct .

5. Loose supplied items: Approximate 300 heater JB for 300 busduct sections, 10 nos. heater marshalling box, around 900 mtrs, conduit pipe for heater wiring, 460 nos. copper flexible, approx. 290 nos. Al strip flexible, 3600 nos. al splice plates.

Other details of SP Busducts	**6.6 KV**
Insulation level	35 KV
Materials (Enclosure)	Al alloy Gr 31000
Material (Conductor)	Al alloy Gr 63401
Enclosure	
Thickness	3.15mm

Barrier thickness : 2 mm

Appox. Wt. Of seal off bushing 15 kg

B) 6.6 KV SP Busduct Details

a) 1600 Amp – From Unit Auxiliary Transformer –3A to 6.6 KV Switch Board 3CA

From Unit Auxiliary Transformer –3 B to 6.6 KV Switch Board 3CB

From Unit Auxiliary Transformer –4 A to 6.6 KV Switch Board 4CA

From Unit Auxiliary Transformer –3 B to 6.6 KV Switch Board 3CB

From 6.6KV Switch Board 3CA to 6.6KV Switch Board 3CC

From 6.6KV Switch Board 3CA to 6.6KV Switch Board 0CC

From 6.6KV Switch Board 3CB to 6.6KV Switch Board 3CD

From 6.6KV Switch Board 3CB to 6.6KV Switch Board 0CD

From 6.6KV Switch Board 3CC to 6.6KV Switch Board 3CD

From 6.6KV Switch Board 0CC to 6.6KV Switch Board 4CA

From 6.6KV Switch Board 0CD to 6.6KV Switch Board 4CB

From 6.6KV Switch Board 4CA to 6.6KV Switch Board 4CC

From 6.6KV Switch Board 4CB to 6.6KV Switch Board 4CD

From 6.6KV Switch Board 4CC to 6.6KV Switch Board 4CD

Approximate Length 620 M and Weight of structure 110.0 MT

b) 2500 Amp. - From BD Tap off to 6.6 KV Switch Board 0CC

From BD Tap off to 6.6 KV Switch Board 0CD

From 6.6KV Switch Board 0CC to 6.6KV Station Switch Board SA

Approximate Length 190 M &Weight of structure 25.MT

c) 4000 Amp – From Station Transformer 3 Upto Tap off

Approximate Length 190 M & Weight of structure 5 MT

c) Busduct Supporting Structure :

Each set of busduct shall be supported with hot dip galvanized / standard steel sections supporting structure which shall be fabricate at site and shall be erected as per drawings. Total weight of support structure shall be approximately140 MT.

6.3.4.4.Scope of works for Busduct

The general scope of works for both isolated and segregated Phase Busduct is as below.

Receipt from BHEL stores / yards, unloading all the busduct materials and accessories and equipment as indicated in the relevant drawings at the area where the busducts are to be erected, inspection, installation of the materials, testing and commissioning of total busduct items, painting and handing over.

Dimension & weights indicated in the Tender Specification and BOQ for isolated / segregated phase bus ducts is only approximate. The relevant drawings are enclosed for the purpose of tendering. The contractor has to ascertain the quantum of work involved and quote the lump sum value as called for in the rate schedule.

There may be variations in the weight and dimensions. Any variation in the length of Busducts within ±20% shall not be considered for price adjustment. However, for variations beyond ± 20%, price adjustment shall be considered proportional to the length of the Busducts. Variations in width or height or weight including support structure shall not be considered for payment.

Detailed scope of work shall as below :

1. Transport of Busducts and associated items / materials and equipment from BHEL Stores to erection site.

2. Cleaning of enclosure and conductors, insulators and other panels before assembly and erection.

3. Placement of embedment and erection and alignment of steel support structures.

4. Assembly and checking of busduct at ground level of necessary.

5. Fixing of wall bushing / wall frame assembly

6. Providing earthing connections as per site conditions.

7. Minor civil work such as chipping and drilling holes on concrete if necessary and grouting of busduct support structures including supply of materials required for civil work.

8. Carrying out required level of cleaning inside as well as outside of the busduct for the purpose of conducting high voltage test before commissioning of the unit.

9. Earthing of Busducts and connecting to earth grid / earth pits as detailed in the relevant bus duct drawings.

10. Carrying out Minor Modification if any that are required during the coarse of erection due to site conditions on any components / items related busduct supply including support structures at no extra cost.

11. Grouting anchor bolts on pockets provided on foundation for the support structures.

12. Extension of embedment it required and erection of required supports structures as detailed in the drawing.

13. Tightening of all bolts in the joints and flanges by torque wrench to the approved pressure (Anti oxidation compound shall be used for joints which shall be arranged by contractor)

14. Conducting air –tightness test after erection to meet the requirement of BHEL / Customer Standards.

15. Rectification of leakage, if any without any extra charges – for air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, rotameter etc. at their cost. Contractors shall tap the air from nearest instruments air tapping point available at site.

16. Conducting high voltage test for IP/SP busducts, short circuit test for IP bus ducts and other tests as detailed in Section VII as per instruction of BHEL engineer after making necessary cleaning inside as well as outside of the busduct & arranging all testing equipment required for carrying out bus duct testing.

17. The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams and should not engage outside agency for testing. Testing shall be done under the supervision of BHEL / CUSTOMER Engineers.

18. Fixing of Current transformers and wiring from CT terminal to junction box/ Marshalling box, taking through rigid / flexible conduit pipe.

19. Fixing of Space Heaters and wiring from space heaters terminal to junction box taking through rigid / flexible conduit pipe.

20. Fixing of Breather wherever required.

21. Scope of work specific for isolated phase busducts

    1. Erection and commissioning of NG cubicle with all its accessories if supplied as loose.

    2. Fixing of neutral side flexible connections to generator and position of neutral CTs after testing..

    3. Erection and commissioning of VT, SP & VT cabicles and its loose equipment / items such as lightning arrestors, voltage transformers, fuses, etc.

    4. Erection and alignment of TEE OFF busducts for unit transformer, SP & VT cubicle etc.

    5. Erection and commissioning of air Blower / dryer equipment with all the accessories.

    6. Carrying out aluminum welding for bus conductor and on enclosure as detailed in the drawing using MIG / TIG machine with the Aluminium filter wire as er BHEL specification.

    7. Providing of MIG / TIG welding machine, aluminum, filler wire, Argon gas of high purity and other required consumables as per BHEL standard for efficient aluminum welding, covering supporting insulators with asbestos cloth whenever aluminium welding is carried out near the supporting insulator.

    8. Making necessary modifications of make up pieces, if required, and welding of isolated phase busducts along with NGT, SP & VT cubicle, UT tap-offs and delta connections.

    9. Conducting 10% radiography and LPT

    10. Providing well, experienced Aluminium welder to be arranged to meet the radiography quality.

11. Grouting the ground bus provided on the entire length of entire length ofbusducts, all part of supporting structures and one end of each enclosure.

12. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.

13. Arranging all T & P material handling equipment required for erection.

14. Calibration of all inspection, measuring and test equipment (IMTEs) before using.

15. Furnishing copy of the calibration certification to the concerned BHEL Engineer for verification and approval.

16. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL /CUSTOMER Engineers, and submitting The same to BHEL as per the instructions of concerned BHEL Engineer.

17. Maintaining the equipment after commissioning till taken over by CUSTOMER or up to contract period.

18. Other requirement for Erection / Commissioning of IP Busducts.

    a) Aluminium welders shall appear for test as directed by the BHEL welding Engineer and only test qualified welders shall be permitted to do the welding.
    b) For MIG / TIG welding only high purity argon gas shall be used. If the contractor is unable to arrange the required high purity Argon gas, the same shall be arranged by BHEL on chargeable basis. The cost of gas shall be recovered from the running bills as per BHEL norms.
    c) Aluminium filler wire/rod shall be procured in consultation with BHEL Welding Engineer from approved Vendors of BHEL.
    d) Make up pieces shall be supplied along with bus ducts. Necessary MIG / TIG welding of different sections of enclosures, make up pieces and bus shall be carried out at site.

e) Holes on the flanges may not be adequate or may not match and any additional holes required same shall be drilled at site to facilitate matching of busduct enclosure flanges including generator flange.

f) /BHEL shall provide 75/18 Ton crane including EOT crane at free of cost. Operators and necessary helpers, and Diesel shall have to be arranged by the Contractor.

g) Matching and connecting the Busduct with other equipment erected by other agencies.

h) Minor modification that may required in the bus conductor / enclosure of the bus duct for matching the switch gear in-comer and transformer adopted box shall be carried out at no extra cost.

6.3.5 SCOPE OF FABRICATION & INSTALLATION OF STEEL MATERIALS

1. Scope of steel fabrication and installation covers, fabrication and installation of various type supports and supports for cable tray, GI pipes, JB, Control, Box / Panel, local push Buttons, busducts etc. with angles and channels of different size.

2. The fabrication steel materials such as angles, channels, plates, etc shall be supplied as standard lengths of supply item.

3. For fabrication, the rate shall be paid on tonnage basis and erection of various supports. ,i.e. the rate quoted shall include fabrication and installation. However, for earthing materials the rates shall be paid on mater basis.

4. Fabrication shall be carried out as per schemes in consultation with site engineers. Immediately after fabrication, primer shall be applied to prevent corrosion. The installation shall be carried out only after applying the primer as detailed in painting clause.

5. For fixing frames of supports, if any minor grouting is required the same shall be carried out at free of cost. After installation of frames, grouting of the same is in the scope of contractor.

6. Supply of all cement, sand etc. required for grouting of supports are in the scope of contractor.

7. All the fabricated steel materials shall be painted as per the detailed in the scope of painting clause and no separate rate shall be paid for painting.

6.3.6 ABOVE GROUND EARTHING & LIGHTNING PROTECTION INSTALLATION

A) Above ground earthing

1. The scope of work shall includes installation of earthing and lightning protection system materials and associated fittings. Others will provide earthing system comprising of main earthing conductor buried in soil, embedded in concrete inside the building. Installation of earthing conductors for connecting equipment pertaining to BOILER / TG/BOP area to the plant main earth grid shall be carried out by the contractor.

2. The unit shall be quoted for earthing on meter basis shall covers supply of fasteners, Saddles, Spacers, lugs, minor civil works etc. the contractor shall lay and connect the earthing materials as per site requirement. Unit rate for earthing material shall be paid on running meter basis.

3. Treated test pits as per drawing No.: PE-DG-219-509-E763 shall be provided.

4. Unit rate for test pit shall be on Nos. basis. The unit rate quoted for Test pit will cover casing of test pit chambers, supply of earth electrodes and all other material including cement, bricks, sand etc.

5. Drawings of main earth grid to be provided by others would be made available to the contractor to enable them to carryout rest of the earthing system work.

6. Earthing system installation scope covers, earthing of all cable trays in inside / outside plant building as well as inside the trenches at an interval as detailed in section VII metallic frames of all current carrying equipment. Supporting structures adjacent to current carrying conductors, lightning protection system conductors and neutral points of various systems / equipment, panels, motors, JB, push button boxes etc. as listed in various drawings.

7. The connection between earthing pads/ terminal to the earth grid shall be made short and direct and shall be free from kinks and splice.

8. Metallic conduits and pipes shall not be used as earth continuity conductor. Pipe racks shall be earthed at every 25 meters. Earth continuity shall be ensured across all flanges joints etc as per earthing drawing,

9. Equipment bolted connection after checking and testing shall be painted with anti-corrosive paint / compound. Connection between the equipment earth lead and the grid conductors shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

10. Dedicated Electronic Earth pits. Supply of anti corrosive paint is in contractor scope.

11. Generator transformer neutral shall be earthed using 2 dedicated rod electrodes, which shall turn be earthed to the main plant gird.

12. Generator transformer Earth pits. Supply of anti corrosive paint is in contractor scope.

13. All electrical equipment operating above 250V shall have two separate and distinct connections to the earth pit.

14. Transformers shall be provided with two dedicated earth electrodes for earthing of neutral and transformer tank earthing. The contractor shall carry out erthing for all Electrical equipment, which may be erected by other agency.

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

16. For different floors in a building, localized internal earthing ring shall be formed and connected to the ground through vertical risers. The earthing mat shall be common to both power and lighting installation.

17. A minimum of two spare earth rings will be provided in each floor of the building for earthing futue building.

18. Each RCC steel column of the building will be interconnected to the floor-earthing grid in basement / ground floor.

19. For Electronic earthing, separate conductor shall be used for flow of earth fault current. All Electronic panels shall be connected separately to Electronic bus which in turn will be connected to electronic earth pit.

B) Lightning protection system installation

1. The scope of works for Lightning Protection system includes installation of vertical air terminations, Horizontal conductors, vertical risers, down conductors, fabrication fixing clamps, test links, and associated minor civil work etc as per drawing PE-Dg-217-509-E260.

2. HORIXONTAL / 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 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. The clamping arrangements shall be provided at a span as specified in the earthing drawing.

3. The unit rate quoted for horizontal and vertical conductor on meter basis shall include supply of supports clamps, saddles, spacers Anchors / fasteners etc.

4. TEST LINKS: The unit rate quoted for Erection of test links installed at different places as shown in the lightning protection drawings, The test link piece shall have same width & thickness as the down comer. All bolts / Nuts / washer shall be of GI.

5. The unit rate quoted for the test link on sets (Nos.) basis shall cover supply of fasteners required for mounting of Test Link, connecting Test link to riser rod of MS 40 mm size, by welding.

6. The unit rate quoted for riser rod shall also covers excavation of earth for laying of riser rod, welding with lightening earth electrodes and Test link down conductor. Refilling of the excavated earth, consolidation etc as shown in the drawing PE-DG-219-509 –E765 sht 8 of 9. Even if the building plinth area has already been consolidated, the same shall be removed, conductors shall be installed welded, refilled and consolidated.

7. VERTICAL AIR TERMINATIONS : The vertical air terminations shall be located in different locations of the buildings as shown in the drawings. 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 as shown in drawing PE-DG-219-509-E765 sht 5 of 9 and supply of grouting materials are in the scope of Contractor

8. The unit rate quoted on sets (Nos) basis for vertical air terminal chipping and minor civil works, grouting and supply of grouting materials. Both vertical and horizontal conductors shall connect the air terminal as per DWG-Pe-219-509-E763.

9. Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations / IS code of practice IS 3043-1947 and Indian Electricity Rules, so that the values of the step and contact potentials in case of faults are kept within safe permissible limits. Parts of all electrical equipment and machinery not intended to be alive shall have two separate and distinct earth connections each to confirm to the stipulation of the Indian Electricity Rules and apparatus rated 240 V and below may have single earth connections

6.3.7 VFD SYSTEMS

The VFD System comprises DC Air Cooled Reactor, LCI Drive panels, PC based
DCS and other control panels, cables etc, including LT power and controls cables, The scope works covers erection of all above panels, integration of total system, commissioning etc. (E&C of VFD Transformer, 11 K VCB and HT cables are not covered in this scope)

SCOPE OF WORK OF CONTROL & PROTECTION PANELS

All these panels shall be installed in VFD Control rooms. The scope works of control & protection panels shall be in line with E&C of LT electrical boards, clause. 6.3.1

Protection panels shall be supplied with loose items like Relays. Recorders, Printers, Indicators, interconnecting cables, etc. as part of panel supply . Any special instruments / testing equipment like secondary injection kits,CRO frequency counter etc. are required for calibration and testing same shall be arranged by the contractor. All the loose supplied items shall be mounted and wired up at free of cost.

6.3.8 **BATTERY AND BATTEY CHARGER**

The batteries are of heavy duty, lead acid batteries type capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden stands. The chargers are fully thyristorised and shall comprise of Silicon Controlled Rectifier with transformer, switchgear and automatic regulation. The float and boost charges will be housed in separate cubicles and mounted side by side, Tentative details are as detailed in the BOM.

SCOPE OF WORK OF BATTERYAND BATTERY CHARGERS

1. Collection of batteries and battery chargers and all the accessories like cable connectors, inter lock connectors, equalizing connectors, rack insulators, fuse box , acid / electrolyte cans etc from stores,

2. Mounting and assembling of Batteries with all loose supplied items filling of acid / electrolyte and testing and commissioning.

3. Conducting load test with suitable resistive load banks or water load for charging and discharging cycles.

4. Arranging complete manpower requirement in shift for battery charging and discharging cycles that may be carried out round the clock as per the code of practice.

5. Modifications or changes if any for the loose supplied items or any minor changes in wiring at no extra cost.

6. Arranging necessary tools T&P, Testing & calibration instruments required for erection and commissioning of the battery and battery chargers.

6.3.9. SCOPE OF WORK OF JUNCTION BOXES / MARSHALLING & PUSH BUTTON BOXES.

Different type of Electrical Junction boxes / Bush button boxes shall be supplied. The scope of installation of Junction boxes/Bush button boxes shall be as follows:

1. The unit rate quoted for erection of junction boxes / push button boxes shall include providing necessary supports drilling of bottom gland plates for cable glands as required, Painting the tag No of JB or fixing a separate tag plate as required on junction boxes / push button boxes, minor chipping, grouting as required for mounting the JBs /PB and supply of all bolts and nuts (fasteners) including grouting bolts as required for mounting the junction box/push button.

2. Fabrication and fixing of supports shall be on tonnage basis,

3. The contractor shall close all unused holes on the gland plates using GROWN MT o other suitable material issued by BHEL, at free of cost.

4. All bolts and nuts (fasteners) required for mounting the junction box shall be arranged by the contractor.

5. If any intermediate JBs are required to terminate power cables for drives, the same shall be installed and also any modification like replacement of terminals, enlarging gland holes etc. required to accommodate power cables shall be carried out as part of this works,. Equivalent Unit rate shall be paid for installation of such JBs. Decision of site engineer will be final regarding the equivalent rate,

6.3.10 SCOPE OF WORK OF CABLES:

BHEL will supply HT and LT cables (1.1 KV, Armoured / Unarmoured, Aluminium / Copper PVC FRSL insulation) of different sizes. The scope of work for cables covered in this tender is as below.

1. The scope includes laying & Termination of cables, drilling of glands holes on gland plates of the panels / JBs, fixing of glands, ferrules, tag plates with necessary numbering and dressing of cable, as per BHEL specification and BHEL engineer's instructions.

2. Unit rates shall be on meter basis. The unit rate quoted for the cabling apart from above shall also include supply of clamping materials, ferrules, tag plates, lugs up to 2.5 Sq.mm contractor scope of supply of materials shall be as per BHEL's specification as detailed in Section VI

3. Cables shall generally be laid on cable trays. However, if the cables are to be routed through or laid in duct bank, conduits, cable shafts etc. the same unit rate shall be paid.

4. Separate rate shall be paid for Lt Power cable termination only.

5. The unit rate for HT cables shall include laying & termination, drilling of holes in the panels, fixing of glands, ferrules, tag plates with necessary numbering, including fixing of Trefoil clams an clamping as per BHEL specification.

6. No Separate rate for cable termination shall be applicable only for HT Cables,

7. For some or the cables, cable trays will not be provided either by BHEL or by customer and such cables have to be routed on the steel angels as per site condition. Steel angels required for the

same will be supplied by BHEL free of cost. Even if the cable support are arranged by the other agency, cable dressing shall be carried out for the cables laid by the contractor. Any fabrication required at site for cable support shall be carried out at extra cost.

8. All the dressing material such as Alu8minum / GI strips, PVC ties etc, required for cable shall be arranged by the contractor at free of cost. The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if cables like illumination cables or any cables of lesser quantity for which no separate trays have been allotted are laid on the same trays, the contractor shall do clamping along with the cables laid by others.

9. Wherever the equipment installed by another agency where they have not provided with cable accessories such as cable gland, holes etc. contractor shall co-operate to get the same done.

10. The unit rate quoted for cable laying shall also cover the following works.

a. Modification such as rotating the terminal box through 90^{o} or 180^{o} as required.

b. Enlargement of cable entry holes, if necessary, by chipping / tapping or nay modification required fixing of able glands,

c. Drilling of gland plates of equipment if not done already.

d. Reaming and relocating holes at actual point of entry of cable or conduit in terminal boxes, outlet boxes, pull boxes etc. cleaning off the debris / trapped material from conduit / ducts

e. In case any existing structure is affected / damaged due to installation work of cables the contractor shall repair the same to the satisfaction of Site Engineer

However any major modification like drilling, tapping etc. are involved in fixing of glands in JBs and Terminal boxes same shall be considered as extra on man hour rate basis as per extra works clause

11. The approximate number of termination for the purpose of estimation to be for control and pair cable shall be assumed as follows : The average RUN length shall be considered as 150 mtrs. However, 10% of the cable the average length shall be considered as 30 mtrs.

12. Irrespective of cable schedule, i.e. whether the laying of cables are covered in Electrical cable schedule or C&I cable schedule, contractor shall lay and terminate the all the cables covered in the BOQ as per directive of site BHEL Engineers.

CABLE TERMINATION

13. For all LT control cable terminations, no, separate rate shall be paid and Lt control cable jointing if any separate rate shall be considered.

14. The scope of termination shall include, termination of cables on various equipment installed by others. The contractor shall work in co-operation with other agencies in obtaining correct direction of rotation and commissioning of the equipment.

15. The insulating sleeves shall be of fire resistant and be long enough to over pass conductor insulation and shall be properly sized,

16. Termination of all the cables laid by the contractor is included in his scope. The work of testing and reconnecting, changing of connectors, the tenderer without additional cost shall carry out rearrangements of leads if required.

17. The contractor shall provide Tools / Equipment required for the connections and termination of cable wherever necessary.

18. Necessary lugs above 2.5 sq.mm. shall be supplied by BHEL

19. After cable terminations the debris shall be removed then & there

20. For HT cable termination suitable termination kits shall be supplied and HT cable termination shall be part of installation of HT termination kits. No separate shall be paid for HT termination.

21. Only printed ferrules should be used and necessary ferrules printer shall made available at site.

6.3.11. CABLE TRAYS / CONDUITS / FLEXIBLE ONDUITS

Scope of cable tray works covers erection various sizes of ladder & perforated trays with accessories in Power House building & ESP area that includes able galleries / cable vault and cable shaft and trays required for routing of cables for some of the BOP building. All type of cable trays including, standard trays accessories shall be supplied by BHEL.

The scope of work for cable trays shall be as follows:

A-CABLE TRAYS

1. The unit rate for erection of trays shall be on meter basis. The unit rate quoted for erection of tray shall also include erection of all trays accessories such as elbow, cross, TEEs. Bends (90^{o} vertical and Horizontal,) reducers, coupler plates / fixing plates, anchor bolts, fasteners etc.

2. For routing of trays standard tray accessories supplied by BHEL shall be used. However if above standard tray accessories are not supplied, the same shall be fabricated and installed at no extra cost.

3. During erection of Trays if standard tray accessories like TEES, Reducers, Bends (90^{o} vertical and Horizontal,) cross etc supplied by BHEL requires any modification to suit the tray routing, the same shall be carried out at no extra cost.

4. No separate rate shall be paid for any such site fabrication / modification on trays or on trays accessories.

5. The contractor shall quote a uniform rate on meter basis for erection of trays and Trays accessories like TEES, Reducers, Bends (90^{o} vertical and Horizontal) cross.

6. The unit rate quoted for trays shall also cover making of offsets by means of cutting standard tray sections and inserting additional tray fittings to match with the existing arrangement, minor bends, cutting, reducing length etc i.e. any TEES, Reducers, Bends (90^{o} vertical and Horizontal) cross / fabrication required at site on trays and accessories same shall be carried out at no extra cost.

7. Trays covers are to be erected after completion of cable lying and no separate payment will be made for fixing these covers. GI strip clamps are to be used for fixing the tray covers.

8. Welded joints of trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS3043. The unit rate shall also include supply of paints, thinner, other consumables and brush etc

B-REGID & FLEXIBLE CONDUITS

1. Cables shall normally be laid on cable trays. However, in case of shorter router where trays are not possible, suitable GI pipe / flexible conduits shall be used. Unit rate shall be paid on running meter basis.

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

3. In the cast of flexible conduit laying for fixing end connectors, no separate payment will be made for connectors,.

4. GI pipes and flexible conduits shall be supplied by BHEL

6.3.12 SCOPE OF PAINTING :

1. The scope of painting generally covers all steel works such as cable supports, racks, frames, canopy, Tray modification etc fabrication and erected by the contractor.

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

3. Hand / Power tools for cleaning, required for the contractor at his cost shall arrange surface preparation,.

4. In order to achieve maximum durability, one or more of following methods, of surface preparation shall be followed, depending on condition of steel surface and as per instructions of BHEL Engineer.

    - Mechanical or power tool cleaning
    - Manual or hand tool cleaning

5. The paint materials shall be synthetic enamel of Epoxy.

6. The shades of successive coating should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and completer coverage.

7. Unless otherwise instructed, final painting shall be painted in the field, only after mechanical completion and testing on system are completed.

8. Paints shall be arranged from standard reputed suppliers in consultation with BHEL. All painting materials brought to site by contractor for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

9. Touch up painting only is generally required for trays, junction boxes etc and full painting shall be required only for specific equipment such as Busducts, Transformer etc, as per the scope of erection.

10. All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.

11. No separate rate shall be paid for painting and supply of paints, and other consumables, Painting shall be accommodated in the unit rate quoted for items which calls for painting as per scope of work.

12. The paint manufacturer's instructions shall be followed as far as practicable at all times. Particular attention shall be paid to instructions for storage to avoid exposure as well as extremes of temperature, surface preparation prior to painting, Mixing and thinning, Application of paints and the recommended limit on time intervals coat.

6.3.13 SCOPE OF CALIBRATION AND TESTING:

1. Contractor shall calibrate all the local instruments, panel mounted instruments like protection relays, transducers, Recorders, Indicators, energy meter etc that will be supplied along with equipments mounted in or in loose.

2. Contractor shall calibration records as per the format CP:PEX:FOX enclosed in the tender specification.

3. All testing instruments / Equipment deployed for calibration shall be calibrated before taking it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for his verification and approval.

4. All testing instruments shall have calibration certificate issued by recognized / accredited agencies.

5. BHEL shall provide vendors supports for proprietary type of microprocessor based instruments, protection relays which requires software loading and programmer etc. However overall responsibility lies with contractor and Contractor shall provide all supports like manpower, standard T&P instruments etc for calibration and testing of above proprietary type instruments.

6. If BHEL unable provide or arrange vendor support for above mentioned proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by out side agency shall be absorbed by BHEL. However if above such calibrator is available with BHEL at site the calibration shall be carried out by the contractor at free of cost.

7. The contractor shall carry out calibration with their own calibration and testing equipments and Testing teams and should not engage outside agency for calibration and testing. Calibration and Testing shall be done under the supervision of BHEL/CUSTOMER Engineers.

6.3.14 SCOPE OF CIVIL WORKS

The scope of civil works covers minor civil works like, drilling, chipping and punching & opening in concrete floors, slabs, brick walls, grouting of foundation bus duct columns, base frame of panels, Transformer etc. Scope of civil works also covers minor civil works required for installation of pushbutton stations, Junction Boxes.

Scope of civil works includes supply of grouting materials like cements, sand, etc., and cleaning of all debris at free of cost

More details regarding scope of civil works are given in the respective equipment erection.

6.3.15 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR

1. All types of HT Drivers and Generator

a. Cable identification, checking and meggering.

b. IR value of motor, measurement of winding resistance etc.

c. Dryout all the motors if required to improve IR value.

d. Checking direction of rotation of motors and testing and commissioning from local as well as remote.

e. Checking the bushing and HV test / Tan delta test & rotor impedenance test

f. Attending to any defects till the handing over of the unit to customer.

g. Checking and commissioning of main exciter and pilot exciter, stroboscope, CO_2 flash operator, heaters of generator.

2. ESP Transformer

a. Dry out of transformer (Oil filtration) till achieving desired BDV, IR Value, calibration of oil temperature gauges, Checking of breather gauge, HV Test etc, i.e. scope of commissioning of ESP Transformer shall be in line with VFD transformers erected by the contractor.

b. Replacing defective components like Temperature gauges, breather
Glass etc.

c. Attending to any defects till handing over of the unit to customer by BHEL.

3. All type of drives and motor operator valves

a) Cable identification, checking and meggering

b) IR value of motor, measurement of winding resistance etc

c) Dryout all the motors if required to improve IR value

d) Limit switch and torque switch setting

e) Calibration of Electronic cards, modules, etc,. and fixing the same if supplied as loose item.

f) Checking direction of rotation of motor and testing and commissioning from local as well as remote.

g) Attending to any defects till the handing over the unit to customer ny BHEL

h) Replacing defective components like limit switches, electronic cards etc.

4. Panels

The panels shall be mostly skid mounted and the skid will be erected by mechanical contractor. The scope of commissioning of Panels covers checking of internal wiring and associated loop cables from panels to file instruments, Push Buttons, JBs, drives, replacing defective components / instruments / electronic cards etc.

If any loop cables (power or control) are to be laid or replaced, the same shall be carried out at unit rates available in the BOQ,

For commissioning of associated drives, if any, the unit rate will be as per BOQ and this will not be part of panel commissioning.

5. Hoist :

All cabling will be carried out by the vendors. However the scope of works of hoist covers besides works mentioned in SI No.1, the checking of control panels wiring, field wiring like push button, motors, limit switch etc., fixing of Trailing cables, and making ready for load test by mechanical agency.

6. ESP Heating Elements and Thermostats

a) Checking the healthiness of Elements and Thermostats.

b) Setting the value

d) Replacement of defective Elements and Thermostats.

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

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

i) Trial run of various equipment

ii) Light up of boiler

iii) Boiler acid cleaning

iv) Boiler alkali boil out

v) Steam blowing of piping

vi) Steam blowing of piping

vii) Turbine rolling

viii) Safety valve floating

ix) First synchronisation

x) Heavy oil firing and synchronisation

xi) Coal firing

xii) Trial operation / Full load

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

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

4. The pre-commissioning activities of the main power plant shall start with energizing of start up power supply systems followed by trial run of various drives prior to light up of boiler. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by him to match with the various milestone activities / commissioning programme of the project. All these works need specialized testing engineers, supervisors including electricians in each area to co-ordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted for erection

5. The mobilization of testing team shall be planned in time and shall be undertaken round the clock. The contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower. Consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T& P are not

arranged then BHEL shall make alternate arrangements and the cost shall be recovered from contractor.

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

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

8. Minimum requirement of Man power for testing / checking works shall be as follow:

		TRANSFORMER	BUS DUCT	SWITCHGEAR/CONTROL
-	Engineer	1	1	1
- -	Supervisor	2	2	3
-	Technician	3	3	6

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

10. T&P instruments required for testing are to be arranged by the contractor

11. All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in

accordance with the checklist. All the above shall be witnessed by BHEL engineer and the reports signed jointly.

12. The scope of commissioning assistances to be provided by the contractor shall cover the equipment / drives erected by the mechanical contractors as detailed in the BOQ.

6.4.0 TIME SCHEDULE

6.4.1 The contractor shall mobilize his resources and work force within two weeks from the date of telegraphic LOI in such a manner that the entire electrical work covered in his scope is completed to match the following commissioning program for unit-3

1) Boiler Light up	6 months from start of work.
2) Barring Gear	8 Months from start of work
3) Synchronization	9 Months from start of work
4) Full Load / Trial operation	12 months from start of work
5) Handing over	12 months form start of work

6.4.2. Commissioning program for unit-4 shall be in a phase shift of 3 months.

6.4.3. BHEL, owing to its commitment to their customer, may ask contractor to compress the total completion schedule. Contractor shall plan his activities and mobilize additional resources accordingly to the satisfaction of BHEL engineer within the quoted rated.

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

6.4.5. Subject to availability of materials and other inputs, it is the responsibility of the contractor to carry out work to achieve the monthly progress and keep up the schedules.

6.4.6. Contractor shall draw the monthly erection programme along with BHEL engineer indicating the work to be achieved and events to be completed, once the programme is drawn, he shall adhere to the same. Contractor shall plan and erect the materials as it is received at site. The monthly planned percentage shall take into consideration the material available at site before the start of the moth and also any material received during the

month. Contractor shall mobilize his resources required to achieve the monthly programmes.

6.4.7. The entire scope of work erection, testing and commissioning shall be completed within 18 months as detailed in overall erection commissioning programs.

6.4.8. The work under this scope of contract is deemed to be completed in all respects only when all the items / materials / equipment are erected and trial runs, testing and commissioning the equipment are completed. The decision of BHEL in this respect shall be final and binding with the contractor.

6.4.9. During the tenure of contract, if BHEL is not satisfied with the progress of work, BHEL have the right to withdraw any portion of work / balance work and get the same done either directly employing their own personnel or through other agency at the risk & cost of the contractor. The contractor shall not be entitled for any compensation whatsoever in this regard.

6.5.0 STORAGE :

6.5.1 The equipment should be preferably in its original package and should 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.

6.5.2 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 shall also help in lifting the packing with fort lift truck.

6.5.3 Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaces when decolorisation takes place or regenerated.

6.5.4 Due care should be taken to ensure that the equipment is not expose to fumes gases etc. Which can affect electrical contacts of relays and terminal boads.

6.5.5 The storage room and the equipment should be checked at regular interval of 3 months to ensure protection from termites, mould growth, condensation of water etc., which can damage the equipment.

6.5.6 All the equipment, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to site.

6.5.7 Packing material shall be retained if the cubicle to the repacked after inspection.

6.5.8 Sub-Assemblies

a) All sub-assemblies should be kept in a separate place where it is easily accessible.
b) Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should be also be kept along with it.

c) Sub- assemblies should not be stacked one above the other.

6.5.9 Loose items (wherever applicable)

The loose items supplied for the main equipment falling into various categories like tools, cables, recorders and display units, cable glands, frames etc. are to be categorized and stored separately.

6.6.0 TERMS OF PAYMENT :

The contractor should submit his monthly on account monthly bill with all the details required by BHEL on specified date month covering progress of work in all respects and area from the 25th of previous calender month to 24th of the current month.

6.6.1. For transformers :

a. Receipt, transport to the placement of erection on Placement, Assembly, aligment, grouting mounting and wiring loose part on Pro rata basis.	50%
b. Oil filling (gas filling) filtration, mechanical operation checking on pro rata basis	20%
c. Pre commissioning checks, tests, calibration and energisation and commissioning on pro rata basis	20%
d. On submission and passing of final bill	5%
e. After guarantee period	5%

6.6.2. For HT / LT switchgear and control panels

a. Receipt , Transport to erection site on placement, assembly fixing and clamping on pro rata basis	50%

b. Adjustment, Alignment, grouting and on pro rata basis electrical interconnections 20%

c. Pre-commissioning tests, checks, calibration and making ready for energisation on pro rata basis 20%

d. On submission and passing of final bill 5%

e. After guarantee period 5%

6.6.3. Laying and termination of HT cable

a. Laying / tagging / termination on pro rata basis and protocol signed 70%

b. Checking, Fixing Trefoil calmps and Highpo test on pro rata basis and protocol is signed 20%

c. On submission of as built drawing and final bill passing 5%

d. After guarantee period 5%

6.6.4 For VFD systems

a. Receipt, transport to erection site on pro rata basis 70%
Placement, assembly fixing and clamping on pro rata basis
Adjustment, alignment, grouting and electrical
Interconnections and oil filtrating on pro rata basis

b. Pre- commissioning tests, checks, calibration and making ready for energisation on pro rata basis 20%

c, On submission of final bill and passing 5%

d. After guarantee period 5%

6.6.5 For Battery Sets Charger :

a. Receipt, transport to erection site, checking, placement, assembly, grouting Mounting and wiring of loose components
Adjustment, alignment, inter connections and pouring of Alkali 70%

b. Pre commissioning test checks, and making ready for Energisation 20%

c. Completion of pending points & submission of final bill and passing 5%

d. After guarantee period 5%

6.6.6. For cable laying & Termination

a. Laying and tagging on pro rata rate basis 70%

b. After termination and dressing on pro rata rate basis 20%

c. On submission of built drawing and final bill passing 5%

d. After guarantee period 5%

6.6.7. For fabrication and installation of steel material

a. After fabrication and applying of primer on prorate basis 50%

b. After installation on pro rata rate basis 40%

c. On completion of painting 2%

d. Submission of final bill and passing 3%

e. After guarantee period 5%

6.6.8. For cable Trays, Tray supports, Rigid & Flexible conduits, Above Ground Earthing

a. After satisfactory completion of work on pro rata rate basis 70%

b. After completing drawing wise on pro rata rate basis 20%

c. On submission of final bill and passing 5%

d. After guarantee period 5%

6.6.9. FOR OTHER ITEMS WHICH ARE NOT COVERED IN THE ABOVE TERMS OF PAYMENT, THE PAYMENT SHALL BE MADE AS UNDER.

a. 75% of the accepted rate for the respective item of work on pro rata basis on satisfactory completion of work.

b. 15% of the accepted rate on commissioning of the system

c. 5% on submission and passing of final bill

d. 5% after guarantee period

6.6.10 The Guarantee amount of 5% of the contract value (arrived at the actual quantity erected multiplied by unit rate accepted) will be paid after the guarantee period of 12 months is over separately. The guarantee period shall commence from the date of completion of trail run of the unit or 6 months from the date of first synchronization of the set whichever is earlier, provided all erection, testing and commissioning works are completed in all respects. However the above 5% payment can be released against submission of a matching Bank guarantee from a nationalized / Schedule Bank in the prescribed Proforma of BHEL valid for one year from the date commencement of guarantee period.

6.6.11 BHEL at discretion, may further splitup the above percentage and effect payment to suit the site conditions, cash flow requirements, according to the progress of work.

6.6.12 Field Quality assurance formats: It is the responsibility of the contractor to collect and fill up the relevant FQA Log sheets/Welding logs & Heat treatment charts and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL/ Customer in token of their acceptance. Monthly RB Payment to the contractor will be linked with the submission of these Log sheets.

6.6.13 No levy or payment or charge made or imposed shall be impeached by reasons for any clerical error or demanded or charged.

6.6.14 CONTRACTOR SHALL NOTE THAT THE FINAL BILL BE RELEASED ONLY ON PRODUCTION OF A CERTIFICATE ISSUED BY SITE IN CHARGE THAT THE CONTRACTOR HAS FULFILLED ALL THE CONTRACTUAL / STATUTORY REQUIREMENT.

6.7.0 GUARANTEE

6.7.1 All the works executed by the contractor are to be guarantee for a period of 12 months from the date of taking over of the work. The contractor shall be responsible for the quality of workmanship and shall guarantee the work done, shall rectify / replace at free of cost all defects due to faulty erection and commissioning during the guarantee period.

6.7.2 In the event of contractor failing to replace / repair the defective works within the time required BHEL may process to undertake the replacement / repairs of such defective works at the contractor's risk and cost without prejudice to any other points / right.

6.8.0 MATERIALS / CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR FOR ERECTIN AND COMMISSIONING AS PART OF THE SCOPE AT FREE OF COST

01 All type of welding electrodes, Gases

02 Provision for Temporary Scaffoldings

03. Insulation tape.

04. Paints required for primer coating and final coating and for protective coating.

05. Solder wire (Lead) – (60/40)

06. Protocol / Calibration report sheets as per BHEL format.

07. Panel sealing compound material (For cable entry from bottom / Top of Panel)

08. Materials required for cable dressing

09. Ferrules and Tag plates

10. Lugs above 2.5 Sqmm

6.9.0 EXTRA CHARGES FOR MODIFICATION AND RECTIFICATION WORK

a) BHEL may consider payment for extra works on man day basis for such of those works which require major revamping / rework/rectification/modification which is totally unusual to normal erection or commissioning work which are not due to contractor's faulty erection.

b) The contractor may submit his work claim bills (Specifically agreed by BHEL Engineer) along with the labour sheet duly certified by BHEL Engineer at site. But BHEL also got the option to get these work done through other agencies if they so desire. The decision of BHEL in this regard shall be final and binding on the contractor.

6.9.1 All the extra work, if any, carried out should be done by a separate gang which should be identified prior to start of work for certification, of man hours. Daily labour sheets should be maintained and should be signed by contractor's representative and BHEL Engineer. Signing of the labour sheets does not necessarily mean the acceptance of extra works. Only those works which are identified as not usual to normal erection and certified so by the Project Manager, and accepted by designer/supplier or competent authority only will be considered for payment.

6.9.2 The decision of BHEL in this regard shall be final and binding on the contractor.

6.9.3 The following man hour rates will be applicable for modification/rectification work.

6.9.4 Average single man hour rate including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, including consumables for carrying out any rework, re-vamping as may arise during the course of erection Rs.40/- man hour.

6.9.5 Average single man hour rate including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals excluding consumables for carrying out any rework/revamping as may arise during the course of erection Rs.25/- per man hour.

6.10.0 EXTRA WORK DOES NOT INCLUDE

6.10.1 Nominal dressing of foundations, holes, bases, nuts and bolts, in case of abnormal conditions, this can be mutually discussed before starting of such work.

6.10.2 Extra works are broadly defined as below:

Design changes which will be intimated to the contractor after the start of erection and same refers to dismantling of erected components rectification of components which have been received in damaged conditions during transit, rectification of components wrongly manufactured at work, any other works which do not fall in the scope of this contract.

6.10.3 The decision of BHEL in this regard shall be final and binding on the contractor.

6.11.0 OVER RUN CHARGES

6.11.1 Incase due to reasons not attributable to the contractor, the work gets delayed and completion time gets extended beyond **Eighteen (18) months** from the date of commencement of the work, the contractor shall not be entitled for any over run compensation (ORC) for a period of first **Three (3) months** after the expiry of **Eighteen (18) months**. Incase ORC arises the same will apply at **Rs.25,000/- (Rupees Twenty Five Thousand only)** per month for extension of the completion period beyond **21(18+3) months** as stated above duly taking into account the balance work at the end of that period.

6.11.2 The period of overrun will have to be ascertained before the commencement of grace period.

6.11.3 During the period of over run targets will be fixed on month to month basis, which have to be adhered. In case of any shortfall due to the reasons attributable to the contractor, ORC amount will be proportionately reduced.

6.11.4 The payment of overrun charges for extended stay for reasons not attributable to contractor will be subject to achieving the monthly programme of work as mutually agreed upon during the extended stay.

6.12.0 PRICE ESCALATION

6.12.1 The quoted / accepted rate has to be kept firm for the entire contractual period including total extended period if any and no claim for revision of rates is allowed under any circumstances.

6.12.2 However the contractor shall maintain sufficient work force and other resources required for completion of the job expeditiously for the entire contractual period including total extended period.

6.13.0 TAXES

6.13.1 Not withstanding the fact that this is only an erection service contract not involving any transfer of materials whatsoever and not attracting any sales tax liability, being labour oriented job work, for the purpose of Sales Tax the contractor has to maintain the complete data relating to the expenditure incurred towards wages etc. in respect of the staff/workers employed for this work as also details of purchase of materials like consumables, spares etc., interalia indicating the name of the supplier, address and ST Registration No. and ST paid and should furnish to BHEL at the year end.

6.13.2 The contractor has to register under local Sales Tax-Law and get assessed. The contractor has to give a certificate each year that the returns are submitted regularly and the turnover on this contract is included in his sales tax return. The sales tax registration number and certificate is to be furnished at site soon after the award of contract. However in case delay is anticipated in obtaining S.T. Regn.No. a copy of application for registration filed with ST authorities shall be submitted along with first running bill and the ST Regn.No. will have to be submitted within a reasonable time.

6.13.3 The final bill amount would be paid only after submission of proof of inclusion of the turnover of this contract in the ST Returns or ST Clearance certificate. The ST deduction at source will be made from running bills, unless necessary exemption is produced.

6.13.4 IMPORTANT CONDITIONS FOR PAYMENT

It may be noted that the first running bill will be released only on production of the following.

i. PF Regn. No.

ii. Labour Licence No.

iii. Workmen Insurance Policy No.

iv. Un Qualified Acceptance for Detailed L.O.I.

v. Initial 50% Security Deposit.

vi. Rs. 100/- Stamp Paper for Preparation of contract agreement

6.14.0 PROVIDENT FUND & MINIMUM WAGES

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

6.14.2 The contractor shall ensure the payment of minimum labour wages to the workmen under him as per the rules applicable from time to time in the state.

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

6.15.0 OTHER STATUTORY REQUIREMENTS

1) The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no alongwith the **first** running bill.

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

3) The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of

Wages. Incase of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contactor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

4) The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen under I D Act 1948, copies of Form 6-A(Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act1948 (If applicable) to BHEL along with the Final Bill.

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

6) In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.

6.16.0 SERVICE TAX

Service Tax as applicable for this Contract will be borne by BHEL.

The contractor may claim the Service Tax in their R.A.bill and the same will be paid by BHEL, on production of copy of registration certificate. Proof of remittance of service tax by the contractor to the service tax authorities, relating to previous RA bill, has to be produced from the second running bill onwards.

6.16.1 TAXES, DUTIES, LEVIES

Refer to clause 2.8.4 of general conditions of contract in this regard. Except service Tax and New levies / Taxes imposed by Govt during execution period.

New Levies / Taxes

In case the government imposes any new levy / Tax after award of the work, BHEL shall reimburse the same at actual's on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / Tax is applicable to this contract. No reimbursement on account of increase in the rate of existing levies shall be made.

6.17.0 ELECTRICAL INSPECTORATE'S APPROVAL :

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

- Completion certificate for all the equipment covered in the contract.

- Copy of test results conducted at site for all the equipment including Electrical equipment erected by Mechanical Contractor.

- All other documents as required by statutory authority

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

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

  BHEL shall pay all other fees (FEES FOR VISITS, INSPECTION FEES, REGISTRATIN FEES ETC) However any expenditure related to documentation shall be borne by contractor.

6.18.0 PROGRESS AND MONITORING OF WORK

6.18.1 It is the responsibility of the contractor to provide all relevant information on a regular basis regarding erection progress labour availability, equipment deployment, testing, etc.

6.18.2 The contractor shall submit daily, weekly and monthly progress reports, manpower, reports, material reports, equipment reports etc. as per formats specified by BHEL. The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, in any. The report shall also give removal actions which the contractor intends to make good the slippage or lost time so that further works can proceed as

per the original plan the slippages do not accumulate and affect the overall programme.

6.18.3 The contractor to reflect actual progress achieved during the month and shall be submitted to BHEL, so that slippages can be observed and necessary action taken in order to ensure that the situation does not get out of control shall update the construction schedule forming part of this contact each month.

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

6.18.5 In addition a weekly / fortnightly progress meeting shall be held at BHEL site office for coordinating job progress and all agreements reached there at shall be maintained.

6.18.6 Wherever erection sequences are furnished by BHEL, the contractor shall follow the same sequence.

6.18.7 The contractor shall submit daily report of the number of men by craft on the job, showing where men are working, type of work being performed by area of system as required by BHEL.

6.19.0 INSPECTION OF WORKS

6.19.1 BHEL / Customer shall have full power and authority to inspect the works at any time. Either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account shall the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by CUSTOMER. Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

6.20.0 REPORTING DAMAGES AND CARRYING OUT REPAIRS

6.20.1 Checking all components / equipments at siding / site and reporting and reporting to transport and / or insurance authorities of any damages / losses shall be by BHEL

6.20.2 Contractor shall render all help to BHEL in inspection including handling, re-stacking etc, assessing and preparing estimates for repairs of components damaged during transit, storage and erection, commissioning and preparing estimates for fabrication of materials lost/ damaged during transit, storage and erection. Contractor shall help BHEL to furnish all the data required by railways, insurance company or their surveyors.

6.20.3 Contractor, shall report to BHEL in writing any damages to equipments / components on receipt, storing, and during drawl of the materials from stores, in transit to site and unloading at place of work and during erection and commissioning. The above report shall be as prescribed by BHEL site management. Any consequential loss arising out of out-compliance of this stipulation shall be borne by contractor.

6.20.4 Contractor shall carry out fabrication of any material lost as per instructions from BHEL engineer.

6.20.5 BHEL, however, retains the right to award or not to award to the contractor any of the rectification / rework / repairs of damages and also fabrication of components.

6.20.6 All the repairs / rectification / rework of damages and fabrication of materials lost, if any, shall be carried out by a separately identifiable gang for certification of manhours. Daily log sheets should be maintained for each work separately and should be signed by contractor's representative and BHEL engineer. Signing of log sheets does not necessarily mean the acceptance of these as extra works.

6.20.7 All rectification, repairs, rework and fabrication of components lost, which are minor and incidental to erection work (consuming not more than 100 manhours on each occasion) shall be treated as part of work without any extra cost.

6.20.8 Payments for all extra works for repair / rectification / reworks of damages and fabrication of materials lost shall be as per provisions of clause 3.8.

6.20.9 In case the repairs / rectification / rework and fabrication of materials lost, the work has been done by more than one agency including the contractor, the payment towards extra charges shall be on pro-rata basis and the decision of BHEL in this regard is final and binding on the contractor.

6.21.0 MANPOWER REQUIREMENT

Manpower requirement for Erection and Commissioning shall as follows:

6.21.1 There shall be a Resident manager as Site in charge at site, under whom there shall be 3 erection engineers who shall be in charges or TRANSFORMER & BUSDUCT, SWITHGEAR & CONTROL PANELS AND CABLES.

6.21.2 Each area engineer shall be provided with minimum four supervisors and adequate number of Technicians / electricians and other erection staff and T&P etc. The testing Engineers / Supervisors / electricians shall be identified separately for each package and the minimum requirement shall be as indicated in Clause 6.3.10 Besides, there shall be separate engineers for Planning, Safety and Quality.

6.21.3 The Site in charge shall be provided with PCS and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities shall not be an excuse for extension of completion date.

6.21.4 All instructions from BHEL / Customer shall be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name his authorized representative prior to or immediately on commencement of operations at site.

6.21.5 The Site in Charge shall be present at site during all normal working hours and his contact address after normal working hours shall be made available to BHEL so that if any emergency arise, the presence of the contractor's site Representative at sire can be called for.

6.21.6 The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed to suffer delay on this account.

6.21.7 The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of his duties the contractor shall remove them from site as directed by Site Engineer.

6.21.8 The contractor shall ensure that all his supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the Contractor's personnel shall be brought to the attention of the contractor's site representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required b the Engineer-in-Charge.

6.21.9 The contractor shall ensure that replacement for such persons removed from site are provided immediately and the works is not allowed to suffer delay on that account.

6.22.0 DETAILS TO BE FURNISHED BY THE TENDERERS

Apart from other details called for in the tender document under the various other provisions, the following details shall be submitted by the tenderers alsong with their offers. Please also refer the check list.

a. HQ Organization chart

b. Site Organization Chart Covering various function

c. Month wise Manpower deployment plan

d. T&P deployment plan

e. Erection Schedule

f. A copy of Electrical license.

Tenderers shall go through very carefully all the provisions under section VI and shall submit manpower deployment plant as per appendix VI A. The list of T&P and instruments that are available with him for mobilization for the work, as specified in Appendix VI B, shall also be submitted by the contractor along with his offer. Tenderers shall indicate the present location and submit a schedule of tools and plants for this site to meet the schedules of erection and commissioning.

6.23.0 DOCUMENTATION

6.23.1 The following information shall be furnished within two weeks of award of contrct for purchaser's approval

a. Bar chart covering planned activities at site.

b. Detailed organization chart.

6.23.2 The following information shall be furnished after testing and inspection :

Test certifications of various tests conducted at site.

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

6.24.0 TOOLS AND PLANT TO BE ARRANGED BY THE CONTRACTOR

6.24.1 Equipment, vehicles, tools and plants and material brought to site by the contractor from his resources shall have distinctive identification marks and the description and quantity shall be intimated to BHEL in writing by the contractor.

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

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

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

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

6.25.0 EQUIPMENT FOR TESTING & COMMISSIONING :

6.25.1. The following testing equipment / T&P shall be brought to site by contractor in sufficient number to carryout the job simultaneously in more than one area.

a) Insulation tester :

i). Motorised megger – 0-1000 – 2000 – 5000V, 0-25000 M ohmns.

ii). Hand operated magger – 0.5 KV /1.0KV/2.5KV, 200 – 100M ohms

b) Earth resistance tester 0 to 1, 10 , 100 ohms.

c). Transformer oil test kit.

d). Torque wrench

e). Voltmeter – ac –0-125.-250-625 V ac

f) Ammeter – ac – 0-2A-10A ac

g) Wattmeter – ac/dc –0-125-250V 0-5-10A.

h) Multimeter – analogue : ac V.2.5V-2500V, ac A-100mA-10A
dc V 25.V-2500V, dc A-50mA – 10A
Resistance – 0-200 M ohms
Digital : voltages ac & dc –100mv – 1000V
Current 10-mA-10A Resistance –0.20M ohms

i) High vacuum stream line oil filter of 6000 and 4500 LPH one No in each.

j) Variac –1/3 phas e- 5A, 15A, 3 Phase –10A, 20A

k) Primary injection kit-0-5000 A.

l) Secondary injection kit –0-5A

m)HV Test kit – 50KV AC 400kVA

n) Wheat stone bridge –0.05m ohm-100 ohm

o) Oscilloscope

p) Air compressor.

q) Oil Tank for transformer oil filtration

r) Vacuum pump.

s) Phase sequence meter- 110V-450V-25 to 65 Hz

t) Frequency meter – 0-115 –230 – 4500-45 –601/s

u) Phase tester – 0-5A – 10A, 30A , 60A, 150A-600A, 500A-1000 A

v) Tachometer etc

x) mA Source

y) Standard pressure gauges

z) Temperature oil bath

aa) Tan Delta Test kit

bb) Oil specific gravity and PPM measuring equipment

cc) Dew point measurement instrument.

6.26.0 ACCURACY REQUIREMENT OF TESTING INSTRUMENTS

SL. No.	INSTRUMENT / TOOL	RANGE	ACCURACY
1.	Power Pack	0 to 50V DC, 3A	±2%
2.	Analog Multimeter	Voltage 2.5 to 2500 V Ac	± 1.0%
		Current 100mA to 10A AC	± 2.0 %
		Current 250 micro A to 1A DC	± 1.5%
		Resistance upto 100 ohms	± 3.0 %
		Voltage 2.5V to 2500 V DC	± 1%
3	Digital Multimeter	Voltage 200m V to 1000 V DC	± 1% + 1 digit
		Philips Voltage 200mV to 1000V AC	± 1% + 1 digit
		Hcl Current 200mA to 20A AC	± 0.8%+1digit
		Philips Current 20mA to 20A AC	± 0.8% +1digit

		Resistance (Hcl) 2120 200* to 200M*	± 0.5%+1digit
		Resistance (Hcl) 2105 200* to 200M*	±0.25%+1digit
		Hcl Voltage 200mA to 750 V	± 0.8%+1digit
		Philips Current 20mA to 20A DC	± 0.5% +1digit
		Hcl Current 20mA to 101 A Ac	± 1% +1digit
4.	Vibration Measuring Equipments	Velocity upto 300 microns	± 0.5% mm/ss
		Displacement upto 300 microns	± 2 Microns
5.	Secondary Injection Kit	Upto 5A	± 0.5 mA
6.	Motor operated Megger	Upto 200 Ohms	±5% at Centre scale
7.	Tongue tester	0/300/600A AC	± 5%
		0 to 300 A DC	± 5%
8.	Tachometer (Hand held)	0 to 4000 rms	± 5%
9.	Phase Sequence Meter		N/A
10.	Three Phase Variac	15 A Capacity	N/A
11.	Feeler Guages	300mm long and 100mm long	± 2microns
12.	Dial gauges	Q	± 0.01 mm
13.	Hand operated Megger 500V/1000V	Upto 200 M ohms	± 5% at center sclae
14.	Motorised Megger 2.5kv	Upto 200 M ohms	± 5% at center scale ± 10% at end of Scale
15.	Earth Megger (Tester)	0 to 1,10,100 ohms	± 5% at center Scale range
16.	Ac Tongue Tester	0 to 300 A Ac	± 3%
17	DC Tongue Tester	0 to 300A DC	± 5%

18.	High Voltage test kit	upto 50KV Ac	± 10%
		upto 70KV DC	± 10%
19.	Tacho Generator (Mech)	0 to 4000 rpm	± 0.25%
20.	DC Ammeter	0 to 300 A	± 10%
21.	DC voltmeter	0 to 500V	± 10%

6.27.0 OTHER REQUIREMENTS OF CONTRACTORS'S INSTRUMENTS T&P

a. The contractor shall arrange all the above, T&P equipment and instruments as indicated except testing instruments which are proprietary in nature.

b. The contractor at his cost shall arrange all cranes and truck / tractor, trailers required for materials handling purpose and also cranes required for erection. If contractor required any equipments other than what is mentioned as free issued from BHEL same can be hired from BHEL on chargeable basis subject to availability.

c. Any other tools and plants instruments and equipment required in addition to the above for the successful completion of this job shall have to be arranged by the contractor at his cost.

d. Necessary accessories for the above shall also be provided by the contractor.

e. The above instruments / equipment shall be sent for testing and calibration wherever from time and maintained by contractor as required by BHEL

f. List of such agencies and periodicity of calibration required for different instruments shall be furnished by BHEL at site.

i. Contractors shall arrange experienced / qualified persons for using these calibration instruments at laboratory and also at work spot.

j. Wherever frequent calibration is required, contractor shall arrange adequate number of instruments such that the work does not suffer for want of test instruments.

APPENDIX –VI A

MONTHWISE MANPOWER DEPLOMENT (NUMBER TO BE INDICATED CATEGORYWISE IN EACH MONTH) BY THE CONTRACTOR

S.NO	CATEGORY	MONTHS
01	Resident Manager	
02	Engineers	
03	Supervisors	
	a. Mechanical	
	b. Electrial	
	c. Industrial Relations/ Safety	
04	Riggers	
05	Fitters	
06	HP Welders	
07	Structure Welders	
08	TIG Welders	
09	Electricians	
10	Store Keeper	
11	Semi skilled and Unskilled workers	
12	Watchman / Security	

N O T E

01. Minimum Number of persons to be indicated monthwise.

02. Above deployment plan shall be discussed with BHEL Site Engineer and necessary changes shall have to be made by the contractor as per discussion. If required, any additional deployment during execution of the work shall have to be arranged by the contractor for meeting various schedules / targets set by BHEL without any additional compensation.

03. Resident Engineer should have a minimum qualification of Engineering Degree or Diploma in Engineering with 15 years of experience in thermal Power Station.

04. Supervisor should have a minimum qualification of Diploma in Engineering or a graduate with 10 to 15 years of experience in Thermal Power Station.

05. Lab Technicians should have experience in Thermal Power Station.

06. Contractor should have one Store Keeper and one Transport Supervisor for the safe transportation of materials.

APPENDIX –VI B

DEPLOYMENT PLAN FOR MAJOR TOOLS AND PLANTS / INSTRUMENTS

(MONTH WISE QUANTITY TO BE INDICATED CATEGORYWISE BY THE CONTRACTOR)

S.NO	CATEGORY	MONTHS	PRESENT LOCATION
01	Welding Generators		
02	Welding Transformer		
03	TIG Welding sets (air cooled)		
04	Insulation Tester a. Motorised Magger 1000&5000 V Grade b. Hand operated Megger 500 & 1000 V Grade		
05	Earth resistance Megger		
06	Transformer Oil testing kit		
07	Torque wrench		
08	Volt Meter / Ammeter / Avometer / other Instrument		
09	Multimeter /Test lamps/ Field telephone sets/ Different gauges		
10	High vac steam line filter Of 6000/4500 LPH for Transformer dryout		

APPENDIX –VI B

DEPLOYMENT PLAN FOR MAJOR TOOLS AND PLANTS / INSTRUMENTS

(MONTH WISE QUANTITY TO BE INDICATED CATEGORYWISE BY THE CONTRACTOR)

S.NO	CATEGORY	MONTHS	PRESENT LOCATION
11	3 Phase /Single Phase Variac 15 Amps		
12	Primary and Secondary Injection testing kits		
13	HV test kit		
14	Resistance Measurement unit		
15	Oscilloscope		
16	5 Amps DC Power Supply unit		
17	Crimping Tools with Various sizes of dyes.		

NOTE

01. The list of Tools and other plants to be deployed for this project may be indicated by the tenderers separately.

02. Above deployment plan shall be discussed with the site engineer and necessary changes shall have to be made by the contractor as per discussions. If required an additional deployment during execution of work shall have to be made by the contractor for meeting various schedules/ targets set by BHEL without any additional compensation.

BHEL PS : SR

CALIBRATION RECORD OF SUB-CONTRACTOR'S INSTRUMENTS

Name of Site :

Name of Sub-contractor :

Sl.No.	NAME OF INSTRUMENT	INSTRUMENT REGN. NO	DATE OF		PERIODICITY OF CALIBRATION	CALIBRATION DETAILS
			ENTRY	EXIT		
						DATE OF CAL. CAL. AGENCY NEXT DUE DATE DATE OF CAL. NEST DUE DATE DATE OF CAL. CAL. AGENCY NEXT DUE DATE

SIGN OF SITE CIC

SECTION VII

RAYALASEEMA TPS UNITS 3 & 4 (2 X 210 MW)

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

7.1.0 INSTALLATION, TESTING & COMMISSIONING IN GENERAL

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

Completion

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

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

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

7.1.0 SITE TESTS AND CHECKS

a) General

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

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

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

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

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

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

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

b) Trial Run Test

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

c) Acceptance Test

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

7.2.0 BUSDUCTS – ISOLATED/SEGREGATED PHASE BUSDUCTS

7.2.1 HANDLING AND STORAGE

General

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

7.2.2 INSPECTION AT SITE :

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

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

b. Physical damage if any during transit.

7.2.3 HANDLING DURING ERECTION :

The busduct are in unpacked conditions, therefore, great care is necessary in handling Ensure that :

a. While lifting enclosure assemblies manila ropes are passed round the busduct enclosure near the support channels.

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

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

d. Eye bolts are used while lifting the cubicles.

On completion of 7.2.3 items must be returned to original packing cases unless required for immediate erection.7.2.3.A

7.2.3ACaution

1. When inspecting the enclosures assemblies etc. the wooden packings, braces and polythene covers should be replaced, if removed, to prevent damage and ingress of duct and moisture.

2. Aluminium being softer material, great care must be taken in handling enclosures and other aluminum items.

3. If the site conditions make it impossible to return the items to the cases for storage:

   a. Nothing must be laid direct on the ground.

   b. All items must be protected against weather and damges.

7.2.4 HANDLING OF BUS DUCT

Handling from deliver station to power station stores :

1. Use suitable slings to lift the packages.

2. No impact should come on the packings while loading. Do not drop from height.

3. Do not stack busduct packings one above the other; also avoid stacking of heavier items on busduct packings.

7.2.5 DURING UNPACKING, HANDLING AND STORAGE

DO's

1. Check all the packings for any damage during transit.

2. Open the packings carefully.

3. Verify material as per shipping list and report any shortage / damage immediately

4. Keep marterial in original packings unless required for erection.

5. Ensore that Manila ropes are used for lifting the busduct

6. Check the tightness of shipping steel clamps while lifting busduct assembly with busbar in position.

7. Ensure that CTs. Las capacitors, N.G. transformer,. Grounding resistor, fuses insulators, wall bushings, moulded and rubber and flexibles are stored in well ventilated area

DON'T s

1. Don't destroy any markings.

2. Don't drop packings from height

3. Don't stack heavier items on busduct packings

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

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

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

7.2.6 DURING ERECTION & COMMISSIONING :

DO's

1. Carry out pre-lay survey to verify that position of various equipment to be
connected, levels of floors and positions of cutouts.

2. Keep the layout drawing etc. ready for reference.

3. Draw the material from stores as per erection sequence.

4. Ensure alignment and proper matching of various enclosures and busbars.
5. Ensure proper alignments of epoxy cast CTs and seal-off bushings before final tightening of hardwares.

6. Make the busbar joints as per the instructions.

7. Ensure aluminium welding by qualified welder only.

8. Take care for proper sealing while joining the enclosure.

9. Ensure proper earthing of enclosure and structure as specified.

10. Check wiring as per relevant wiring diagram.

11. Ensure that CT secondaries are shorted and grounded before HV test on busduct.

DON'Ts

1. Don't allow accumulation of dirt or foreign material inside the enclosure during erection.

2. Don't overtight the bolts.

3. Don't hammer the bolts etc. while joining the busbars if holes are not matching.

4. Don't' forget any foreign material inside the enclosure.

5. Don't allow aluminium welding by unqualified welder.

6. Don't subject IAS, capacitors, and PTs to HT test as these pre-tested and test at site is not required.

7. Don't subject NG transformers to over voltage as these are pre-tested.

8. Don't apply rated voltage unless pre-commissioning checks are completerd.

7.2.7 ERECTION INSTRUCTIONS

A. Packing and Shipping

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

Busducts are usually dispatched as single phase assemblies generally assembled with busbars. The busbars are braced with steel clamps to avoid and damage to insulators and displacement of busbars during transport. Structures, hardwares, flexibles,. And other miscellaneous items are packet separately.

B. Marking :

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

a. Project name and unit number

b. Item no of main BOM this is encircled.

c. Phase marking R, Y or B

d. Work order number

e. Drawing number and item / variant number

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

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

7.2.8 PRE LAYOUT SURVEY

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

7.2.9 PROVISION OF FOUNDATION BOLTS & EMBEDDED ITEM

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

7.2.10 SEQUENCE OF ERECTION

Normally the following sequence of erection is recommended.

A. Erection of steel work :

First all the vertical structures are to be installed, leveled and foundation bolts grouted. Next, place all the longitudinal cross channels in position, adjust the level and bolt / weld them.
Check up the correctness of level and positions of various installed structures. For installation of foundation bolts refer foundation details drawing of the project.

B. Erection of Enclosures :

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

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

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

C. Handling of Busducts :

For handling of busducts specified instructions should be followed.

D. Sequence of erection – enclosure assemblies :

In positioning the various enclosures the following sequence is recommended :

E. Indoor Portion :

(a) Neutral Side

complete the assembly of top chamber / neutral shorting chamber at the working floor as per the drawing. Connect copper flexibles on the generator neutral terminals, and fix it with the generator plate. Provide

temporary support as necessary. Complete the assembly of bottom chamber (if applicable) along with CTs and wiring as per drawing at the working floor and match with the top chamber (if applicable). Now fix the supporting structure. Assemble N.G. Transformer and N.G. Reactor and complete the terminal connections.

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

(b) Line Site

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

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

F. Outdoor Portion :

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

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

The alignment and exact locations of ducts may be verified before proceeding for making the assemblies of make-up piece rubber bellows, wall frame and bolted / welded joints of conductor and enclosures.

G. Busbar Joints :

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

H. Cleaning of Busduct

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

I. Inspection of windows, covers, etc.

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

7.2.11 BUSBAR BOLTED JOINTS

A. Aluminium to Aluminium Joints (Un plated)

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

B. Aluminium to Copper Joints :

Cleaning of Aluminimum surface (Unplated)

Follow instructions given under 7.2.11 A above and apply jointing compound.

Cleaning of copper surfaces (unplated)

Clean the copper contact surface with emery cloth and wipe the surface with clean dry cloth.

Cleaning of copper aluminium surface (unplated)

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

C. Aluminium to Copper Joints using bimetallic strip

For cleaning of aluminium and copper surfaces follow instructions given under 7.2.11 A & B above. Apply jointing compound to aluminium and copper surfaces.

The contact faces of bimetallic strip should also be cleaned as per the above practice and jointing compound applied.

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

D. Cleaning of copper surfaces (Plated)

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

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

7.2.12 CONTACT PRESSURE

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

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

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

7.2.12 RECOMMENDTION FOR WELDED JOINTS

A. Circumferential weld circular section:

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

Welding conditions M.I.G. Process

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

Process	:	4 off 25mm long equispaced tack welds
Gas supply	:	50 Cu. Ft/hr argon
Shield	:	5/8” dia

B. Tubular Conductors :

Tubular Conductors are used in tee-off connections.

Welding conditions M.I.G. Process

Filler wire	:	1.6mm dia (NG 21 with 5% silicon)
Angle	:	10^{o} to 15^{o} Forehand
Cleaning	:	Degrease and scratch brush
Setting	:	215A to 275A, 22 to 2 volts
Gas supply	:	50 Cu. Ft/hr argon
Shield	:	5/8 " dia

C. Enclosures

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

Welding conditions M.I.G. Process :

Filler Wire	:	1.6mm dia (NG 21 with 5% silicon)
Angle	:	10^{o} to 15^{o} Forehand
Cleaning	:	200A to 300A, 25 to 30 Volts (Dependent on thickness)
Gas supply	:	50 Cu. Ft/hr argon
Shield	:	5/8 " dia

D. Drain valve and welding :

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

7.2.14 ELDED BUS ENCLOSURE JOINTS

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

7.2.15 WELDED JOINTS OF SHUNTS

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

7.2.16 DRAIN VALVE WELDING (IF APPLICABLE)

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

7.2.17 FIXING OF NEOPRENE SEAL :

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

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

7.2.18 EARTHING OF ISOLATED / SEGREGATED PHASE BUSDUCT AND CUBICLES

A. General

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

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

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

B. Cubicle earthing :

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

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

7.2.19 SITE TESTS ON ISOLATED / SEGREGATED PHASE BUSDUCT

A. Physical Checks :

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

B. Cleanliness:

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

C. Power Frequency High Voltage Test

Preparation :

Following equipment must be disconnected from busbars removing the bolted link and grounded suitably prior to conducting this test :

a. Generator terminals

b. Unit auxiliary transformer terminals

c. Generator transformer terminals

d. Neutral grounding transformer HV terminal

e. Lightening arresters

f. Capacitors

g. Potential transformer.

It is important to ensure that secondaries of all the current transformers mounted on busbars are shorted and grounded properly before conducting this test.

Ensure that all insulators seal-off bushings are cleaned free from any dust, grease and moisture etc before test.

During the test, ensure the following

a. The generator rotor is kept stationary

b. H.V. Circuit breakers on system side are kept in the open position

D. Test Voltage :

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

For A.C. voltage duration of test shall be one minute.

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

Table – 1

Rated Highest System Voltage	Test Voltage (A.C)	Test Voltage (D.C.)
Uptp & including	KV	
3.6	16.8	
7.2	21.6	
12	28	
24	44	
36	60	

E. Megger-Checks :

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

F. Application of Test Voltage:

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

7.2.20. SITE TEST RECORDS ON ISOLATED PHASE / SEGREGATED PHASE BUSDUCTS :

Test conducted on date …….. Site ……..

Power Frequency high voltage test:

Instrument ……..

Phase	Meggar Reading before after HV test HV test	HV applied & duration A.C. /D.C.	Leakage Current	Remarks
R				
Y				
B				

7.3.0 TRANSFORMER

7.3.1 INSTALLATION

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

7.3.2 INSPECTION

In connection with receiving and unloading at site, and at the final storing place before assembling, the transformers shall be inspected carefully. External visible damages as dents, paint damage etc. may imply that the transformer has been subjected to careless handling during transport and / or re-loading, and a careful investigation is therefore justified.

After the arrival of the material at receiving points, before unloading, the condition of packing and of the visible parts should be checked and possible traces of leaks verified (condenser bushing). If necessary, appropriate statements and claims should be made.

Drums containing oil which have dispatched separately should be examined carefully for leaks or any sign of tampering, all drums are dispatched filled upto their capacity and any shortage should be reported.

Check immediately the gas pressure at the arrival. A positive indicates that the tank and the transformer components respectively are tight, and that the active part including the insulation materials is dry.

If there is no positive gas- pressure, transformer should be immediately filled with dry Nitrogen gas at a pressure of 0.17kg/Cm^2 (2.5psi) without loss of time.

Otherwise, it should be checked if the core isolation is satisfactory and that accessories packed separately have not been damaged during transportation.

7.3.3 UNLOADING

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

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

7.3.4 STORING

Dismantled equipment and components are packed to the protected against normal handling and transport stresses. The instructions for lifting given on the packages, must be complied with to avoid damages.

Goods stored outdoors must be placed directly on the ground, and should be covered carefully with tarpaulin or similar materials.

Oil drum should be stored in horizontal (lying) position with both the bungs also in horizontal position.

7.3.5 LIFTING

Lifting devices on the transformer tank are dimensioned of lifting of the compete transformer filled with oil. The positioning of the lifting devices, permissible lifting angles, minimum height to crane hook and transformer weight, appear from the OGA drawing. Check at lifting of compete transformer that the lifting wires/ropes are not in contact with bushing or other components on the cover.

For lifting with hydraulic jacks, the transformers is provided with jacking pads dimensioned for lifting of complete transformer filled with oil. The position of the pads appear on the OGA drawings.

7.3.6 CHECKS POINTS BEFORE STARTING AND DURING ERECTION

Check points before starting erection.

1. Conditions of leads
2. Bracing, clamping of leads
3. Connections
4. Tap Changer checks
5. General Conditions of insulation
6. Core check that it has not moved in transit.
7. Core-ground ; this is checked with the megger after removing earth connection

8. CTs, including the secondary leads and their passage through metal parts

9. Check that coil position has not moved in transit

10. Check that coil position has not moved in transit

11. Check for dirt, metal swarf, moisture

12. Check that the bushing leads set without being too close to ground or other points of different potential.

b. Check – points during erection:

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

i. Fire – fighting equipment shall be available at the oil – treatment equipment as well as at work in and adjacent to the transformer.

ii. Welding work on or adjacent to the transformer shall be avoided, but if this is not possible, the work shall be supervised by fire-protection personnel.

iii. Smoking on or near the transformer shall not be allowed.

Iv. Transformer tank, control cabinet et, as well as assembling and oil-treatment equipment shall be connected with the permanent earthing system of the station.

v. Check that there is no overpressure in the transformer when blanking plates or connection lids are to be opened.

vi. All loose objects, tools, screws, nuts etc .shall be removed from the transformer cover before opening the connection and blanking lids.

vii. All loose objects (tools, pencils, spectacles etc.) shall be removed from the transformer cover before opening the connection and blanking lids.

viii. Tools to be used inside the transformer e.g. for tightening of screws –joint-shall be fastened to the wrist or another fixed point by means of cotton tape or string.

ix. Tools with loose sleeves and tools with catches must not be used at work inside the transformer.

x. Greatest possible cleanliness shall be observed at work inside the transformer, and at handling of part to be mounted inside the transformer,

xi. Fibrous cleaning materials should not be used as it can deteriorate oil when mixed with it.

xii. All components dispatched separately should be cleaned inside and outside before being fitted.

xiii. A transformer is best protected form damp hazard by circulating warm, de-aerated oil through it until it temperature is 5 C to 10 C above ambient. This should be done before allowing external excess to the interior of the tank. The warm oil should be circulated all the time transformer is open to atmosphere.

xiv. Oil pump & all joints in the oil pipe work should be air tight to avoid entrance of air through leakage joints.

xv. The active part (core and winding) should be exposed to the surrounding air as short time as possible. Open therefore only one blanking plate or connection lid at a time for remounting of bushing, valves etc.

xvi. Objects which-despite all precaution are dropped inside transformer / reator, must absolutely brought up form the equipment.

xvii. Check that the oxygen content inside the transformer tank is minimum 20% if a person is to enter the tank.

7.3.7 ASSEMBLY

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

7.3.8 OIL FILLING

The following procedure is recommended

i. Close and blank the valve to isolate the conservator from main tank. Fill the oil in transformer under vacuum upto Buchholz level as per instructions given else where.

ii. After filling the oil in transformer and breaking the vacuum, oil can be filled in the conservator either through reactor or by drain valve.

iii. Remove the inspection cover (ii) provided on the side of the conservator and check the air cell assuring that it is inflated. The air must remain in fully inflated condition during oil filling operation. If the air cell is found deflated fit the inspection cover and inflate the air cell with dry / nitrogen gas to 0.035 kg/sq.cm.max A gauge may be put by removing plug. After filling close these connections.

iv. Remove air release plugs provided on top of the conservator.

v. Slowly pump the oil through main reactor / drain valve. Temporarily stop filling operation when oil starts coming from opening after ensuring that no air bubbles come out through these air release holes. Fit the two air release plugs.

vi. Continue oil filling till oil start coming from air release plug stop oil after ensuring that no air bubbles come out. Fit the plug.

vii. Now release the air pressure held inside the air cell from point and continue oil filling until magnetic oil gauge indicates 35 deg. C level.

viii. Remove oil pump and connect air cell to breather from point. Also remove pressure gauge and put plug.

ix. The system is now properly filled. Air release plugs are fitted in normal operation.

7.3.9. EQUIPMENT FOR OIL –FILLING UNDER VACUUM

i. High –vacuum 2 storage oil filtration plant provided with thermostat – controlled oil heaters and vacuum – proof hoses with dependent vacuum pumping system for tank evacuation. Capacity : 6000 lph

ii. Oil – storage tanks provided with silicagel breathers and inlet / outlet valves for oil circulation. Recommended capacity 20 KL

iii. Vacuum gauge provided in filtration plant.

iv. Equipment for measurement of electric strength (BDV) of oil – 100 kv set.

v. Equipment for moisture content of oil

vi. Equipment for measurement of Resistivity and Tan delta at 90C

vii. Transparent vacuum – proof tubes for checking of oil-level during oil filling.

viii. Values, fittings, gaskets etc.

ix. Dry nitrogen cylinders.

7.3.10 COMMISSIONING

Testing after Assembly of the Transformer

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

COMMISSIONING CHECKS

SL.NO.	DESCRIPTION
1.	Breather silica gel (Blue when dry)
2.	Oil in the Breather housing cup.
3.	All valves for their correct opening and closing sequence
4.	Oil level in conservator tank.
5.	Oil and cooling system.
6.	Oil level in bushings.
7.	Release sir, wherever necessary.

8. Cooling accessories (Pump motors, Fan motors, etc) for direction and O/L setting
9. Buchholz, oil level indicator, pressure gauges, thermometer, Temp, indicators etc.
10. Neutral earthing.
11. Earth Resistance of Electrodes
12. Earthing of bushing test tap.
13. Check oil leakage for 24 hrs,
14. Check Auxiliary circuit voltage (415 V)
15. Calibration of OTI/WTI with hot oil
16. Check Working of WTI/RTD repeaters at control room.
17. IR of core to earth.
18. Die electric strength of oil PPM & Chemical analysis, specific gravity test
19. IR test on windings to earth and between winding
20. Phase sequence test & vector group check
21. Continuity test
22. No load voltage ratio on all tap position
23. Winding resistance in all taps
24. Tap changing at 415v 3 50 Hz supply in all three phases
25. TAN – DELTA test if quality check list calls for.
26. Dew point check for N2 Gas at the time of oil filling

INSULATION RESISTANCE TEST

Sl.No. Description Date Time in Hrs Megger(not IR Value Temp Remarks less than 550V)

1. Control wiring
2. Tap Changer

a) Motor

b) Control

3. Cooling system

a) Motor Fan

b) Motor pump

c) Control Wiring

4. Main Winding

a) HV/E+: V Not less

b) LV/E+HV+LV than 1000 V

c) HV / IV megger)

d) IV / LV

e) HV /L

Note : -

(1) While checking these values no external, lighting arrestors etc should be in circuit.

(2) Special care should always be taken while meggering the transformer winding to ensure that there is no leakage in the leads.

Oil Characteristics :

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

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

Tests on CT

1. Ratio
2. Polarity
3. Magnetising current
4. IR Value

Potential Transformr Tests

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

On load tap Changer

Sl.No.	Description	Date	Observation	Remarks
1.	Visual inspection of equipment			
2.	Hand operation on II taps.			

3. Complete wiring of the circuits

4. Limit Switch

5. Over running device

6. Remote Panel Wiring.

7. Overload Device of Driving Motor

8. Local Operation (Electrical)

9. Remote Operation (Electrical)

10. Tap Position Indicator.

11. Step by step contractor

12. Out of step relay.

Note :

1. While operating the mechanism on Electrical Control, check once again limit switches, step by step contractor, over running device etc. for their actual operation and prove that they are functioning properly.

2. For More details please refer Respective Manuals.

7.4.0 GUIDELINES FOR ERECTION OF HT SWITCHGEAR PANELS

7.4.1 Erection

The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing woks are to be completed.

7.4.2 All the panels/ board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled creftsmen.

7.4.3 All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel/ interpanel wiring, etc. will have to be done after assembling the panel.

7.4.4 THE FOLLOWING POINTS SHALL BE CHECKED UP DURING ERECTIN

1. Layout of foundation channels.

2. Floor level covered by the panel with respect to main floor level.

3. Location and serial no. of panels

4. Positioning of panels

5. Verticality of switchgear panels within the limit specified.

6. Freeness of Breaker Truck and modules in housing and its manual operation.

7. Earthing of panels and breaker truck to station earth

8. Lugs for termination of HT and LT cables.

9. Mounting and fixing arrangements of Bus bars.

10. Tightening of Busbar jointing bolts as specified.

11. Clearance between :

    i. Phase to Phase

    ii. Phase to earth

12. Minimum clearance for :

    i. Breaker, Truck and moduls withdrawal

    ii. Distance required for maintenance work

13 .Check the operation of :

    i. Remote control

    ii. Various required – closing / tripping/ alarm / indications / interlocks

14. Installation position of insts and relays

    operation of relays and meters by secondary injection.

15. AC/DC supplies for panel
    Final relay settings as per customer requirements.

16. Tightness of terminal connections for HT & LT connections.

17. Opening operation of breaker, manually and electrically.

18. Working of ammeters and voltmeters for their entire range and other panel mounted insts like recorder, indicator etc.

7.4.5. HT SWITCHGEAR TESTS

1. IR test

2. HV one minute P.F test checking of oil level

3. Measurement of contact resistance for HT breakers

4. Test to prove inter changeability of similar parts (including breaker module)

5. Testing of relays as per supplier's commissioning manual

6. Testing and calibration of all meters.

7. Operation of all relays by secondary injection method

8. Testing of CT polarities and CT ratio by primary injection test.

9. Measurement of kneepoint voltage and secondary resistance for CTs used for differential protection.

10. IR and voltage ratio test for PTs.

11. Functional test of all circuit components for each panel / feeder.

12. Test to prove closing / tripping operation at minimum and maximum specified voltage in test and service position.

13. Check for drawout test and service position of breakers for all feeders.

14. Check for covering of all openings in the panel – check for continuity and operation of aux. Contacts of breakers.

15. HV test on vacuum interrupters (for VCBs)

16. Check for pressure of SF6 gas and air (for SF6)

7.5.0 LT SWITCHGEAR PANELS

1. Erection

1.1. The base frames will be supplied normally along with the boards. These will have to be aligned, leveled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing works are to be completed.

1.2. All the panels / board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled creftsmen.

1.3. All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.

2. Checks during erection

12. Layout of foundation channels

13. Floor level covered by the panel with respect to main floor level.

14. Location and serial no. of panels.

15. Positioning of panels.

16. Verticality of switchgear panels within the limit specified.

17. Freeness of Breaker Truck and modules in housing and its manual operation.

18. Earthing of panels and breaker truck to station earth.

19. Lugs for termination of LT cables.

20 Mounting and fixing arrangement of Bus bars,

21. Tightening of Busbar jointing bolts as specified.

22. Clearance between :

    i. Phase to Phase

    ii. Phase to earth

12 Minimum clearance for :

    i. Breaker, Truck and modules withdrawal

    iii. Distance required for maintenance work

13. Check the operation of :

    i. Remote control

    ii. Various required – closing / tripping / alarm / indications / interlocks

14. Installation position of insts and relays

    operation of relays and meters by secondary injection.

15 AC/DC supplies for panel

    Final relay settings as per customer requirements.

16. Tightness of terminal connections for HT & LT connections.

17. Opening operation of breaker, manually and electrically.

18. Working of ammeters and voltmeters for their entire range and other panel mounted insts like recorder, indicator etc.

3 LT Switchgear tests

1. IR test

2. Measurement of contact resistance for LT breakers

3. Test to prove inter changeability of similar parts (including breaker module)

4. Testing of relays as per supplier's commissioning manual.

5. Testing and calibration of all meters

6. Operation of all relays by secondary injection method.

7. Testing of CT polarities and CT ratio by primary injection test

8. Measurement of kneepoint voltage and secondary resistance for CTs used for differential protection

9. IR and voltage ratio test for PTs

10. Functional test of all circuit components for each panel / feeder

11. Test to prove closing / tripping operation at minimum and maximum specified voltage in test and service position.

12. Check for drawout test and service position of breakers for all feeders

13. Check for covering of all openings in the panel – check for continuity and operation of aux. Contacts of breaker.

7.6.0 BATTERY AND BATTERY CHARGER

1. Battery Checks

1. Checking for completion of civil / ventilation requirement of battery room.

2. Checking of adequacy of charger output / requirement w.r.t current required battery charging as per the manual.

3. Check availability of safety devices, water and first aid

4. Check polarity of connections between battery and charger

5. Visual inspection test for level and lekages

6. Checking of layout as per approved drawing

7. Checking of IR value from positive to earth and negative to earth

8. Checking of voltage per cell and total voltage between positive negative and earth to positive / negative and also tap cell voltage (as applicable)

9. Checking of tightness of connectors on each cell

10 Checking of capacity test and hourly measurement of specific gravity and voltage for each cell

2. Battery Charger

1. IR test

2. HV Test

3. Checking voltage ratio of boost float mode transformers.

4. Checking for charging mode of batteris, constant current and constant voltage mode.

5. Load test on chargers by running of DC drives and by liquid resistance system

6. Checking of tightness of earthing connectins.

7. Check for all alarm conditions

8. Checking and calibration of all indicating meters.

9. Check functional operation of charger, auto / manual change over from float to boost and boost to float etc.

10. Checking and setting of all relays.

11. Check AC ripple in boost and float mode after charging.

12. Check polarity of cables connected to battery.

3. Additional Tests

a. Insulation resistance and earth resistance checks.

b. Primary and secondary injection test.

c. Calibration of all instruments

d. Tests at normal voltage and when required are reduced voltage to prove satisfactory closing and tripping from local and remote points, checking of tripping from relay and protective gear, inter-tripping, interlocks etc. Reduced voltage test at 70% rated voltage to prove tripping of each circuit breaker.

e. Battery capacity test

7.7.0 GUIDELINES FOR CABLE LAYING

1 In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.

2. In case of multicore cables of diameter upto 20mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc, by proper clamping at regular intervals of more than 300 mm

3. Power & Control cables installed along builders and structures, ceilings, walls, etc, which are required to be protected against mechanical damage shall be taken in G.I. conduits.

4. GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.

5. In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy duty PVC pipes shall be provided,

6. Entry or cables through, trenches / tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.

7. Cables laid exposed in racks / trays and routed throated through trenches / tunnels / basements etc. to individual drive / control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment is the panels located, above trenches, tunnels, or basement.

8. All cables routed along walls or in equipment rooms shall be protected by means of laying them through GI pipes or by providing sheet metal covers upto a height of 2000 mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be or enclosed type.

9. Tray covers shall not be provided for the cable trays within trenches, tunnels and basements. Non-perforated type sheet steel covers shall be provided for the trays in the areas susceptible to accumulation of coal dust / atmospheric abuses etc.

10. Cable trays shall be supported on ISA 50x50x6mm MS/GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas.

11. Wherever direct heat radiation exists, heat isolating barriers (Subject to customers approval)n for cabling system shall be adopted.

12. For 415 V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded / exposed GI conduits or rigid PVC pipes as applicable.

13. if required, a few number of cables in exceptional areas may be directly buried into the earth.

14. Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth as decided by Engineers.

15. At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled

16. In Corrosive atmosphere, PVC conduits shall be used for cables,

17. Single core cables, when pulled individually shall be taken through PVC pipes only.

18. Laying and installation of power, control and special cables shall generally conform to IS : 1255

19. The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation)

20. In case of higher size cables, the laid out cable shall run over rollers placed at close intervals and finally transferred carefully on the racks / trays. Are shall be taken so that kinks and twist or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used, Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.

21. Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.

22. Cable runs shall be uniformly spaced, properly supported and protected in and approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255

23 All cable shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor / wall crossings, every 25m spacing for straight runs or as specified by Engineer for easy identification of cables.

24. When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.

25. Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.

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

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

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

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

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

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

32. LT Control cables to be laid in the Tray (s) nest below to the LT power cable (Trays)

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

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

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

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

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

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

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

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

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

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

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

44. No single core shall pass through a GI conduit of duct except DC single core cables, AC single core cables shall pass through GT conduits / pipes in trefoil formation only.

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

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

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

48 SUPPORT SPACINGS & CLAMPINGS

Support spacing and clamping suitably provided and as required

49. LAYING OF CABLES DIRECTLY BURIED IN GROUND

Laying and installation of directly buried cables in ground shall conform to be requirements of IS 1255

50. SUPPORT SPACINGS & CLAMPINGS

Trefoil Clamps :

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

Other Clamps

A. Power Cables :

Above 35mm OD

i). Horizontal runs	:	Individually clamped at 3000mm interval (max.)

ii). Vertical Runs : Individually clamped 3000mm interval (mas.)

Upto 35mm OD

i) Horizontal runs : Collectively clamped at 3000 mm interval (max.)

ii) Vertical runs : Collectively clamped at 2000 mm interval (max.)

B. Control cables :

i). Horizontal runs : Collectively clamped at 3000mm interval (max.)

ii) Vertical runs : Collectively clamped at 3000 mm interval (max)

C. Spacing for cables supported along structure / ceiling
Clamping Spacing :

i). In Horizontal runs : 750mm (max)

ii). In Vertical runs : 750 mm (max)

Spacing between cables : 30 mm (min)

Note:

a. Supports shall also be provided at each bend,

c. For any change in above spacing, prior approval of Engineer will be taken

51. CABLE TERMINATION AND JOINTING

1. When the equipment are provided with undrilled gland plates for cable / conduit entry into the equipment, drilling and cutting on the gland plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before drilling holes. Cutting shall not be allowed.

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

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

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

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

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

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

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

9. Cable joints shall normally be made at an intermediate point in the straight urn of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.

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

52. TESTING OF CABLES

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

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

3. Prior to installation, cables shall be tested for :

a. Continuity of conductors.

b. Insulation resistance between conductors & earth

c. Insulation resistance between conductors,

4. After installation cables shall be tested for :

a. Insulation resistance between conductors & iron

b. Insulation resistance between conductors & earth

d. Conductor resistance

e. Capacitance between conductors & earth (for cables above 7C.1.3. KV grade)

f. DC high voltage test (for LT Power cables of higher sizes interconnecting PCCs & MCC)

g. Absence of cross phasing

h. Firmness of terminations.

7.8.0 TESTS FOR THE EQUIPMENT ERECTED BY MECHANICAL CONTRACTOR

The tests to be carried out on the equipment at which are normally being erected by Mechanical contractor.

a. Generator :

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

Following tests shall be carried out n the generators :

1. Insulation resistance test and determination of polarization index value of :

   - Generator

   - Exciter

   - Resistance temperature detectors

2. Dielectric test

3. No load characteristics

4. Short circuit characteristics

5. Temperature rise at rated voltage, current, power factor and frequency.

6. Over-speed test

7. Calculation of efficiency

8. Phase sequence / voltage balance / current balance checks.

   Note :

   1. Vibration tests in the factory to be taken at 100% of synchronous speed and at 120% during overspeed test.

   2. Vibration test at site to be taken at 100% of synchronous speed of th complete generator with its driver.

9. Instantaneous short circuit test (Optional)

10. Noise measurement test.

11. Response of voltage and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively.

12. Temperature detector test.

13. Measurement of DC resistance of winding

14. Inter turn insulation test of stator winding with induced voltage 130% of rated value for 5 minimum (if applicable)

15. Measurement of shaft voltage

16. Tan Delta test for generator bushing .,(if required)

b). AC Motor

1. IR test of stator and rotor windings

2. Heating of both windings upto the permissible temp.

3. Checking / testing of associated switchboard, cables, relays / meter interlocking as mentioned in relevant chapters are completed.

4. Tightness of cable connection.

5. Winding resistance measurement of stator and rotor.

6. Checking continuity of winding.

7. Checking tightness of earth connections.

8. Checking space heaters and carryout heating of winding (if required)

9. Checking direction of rotation in decoupled condition during kick start

10. Measurement of no load current for all phases.

11. Measurement of temperature of body during no load and load conditions.

12. Check for tripping of motor from local / remote switches and from.

13. Checking of vibration (if required)

14. Checking of noise level (if required)

15. Measurement of stator and bearing temperatures during load running (if applicable for every half an hour interval till saturation comes.)

16. Checking operation of speed switch (if there)

17. Checking of polarization index of stator windows, R10/R1 by motorized megger(The value should not be less than 2.0)R60/10 absorption coefficient shall not be less than 1.5

18. Dielectric test.

B) DC Motor

1. IR measurement and heating the winding as per heating curve.

2. Check for earth connection

3. Winding resistance for field and armature.

4. Check running of drive at minimum and maximum specified.

5. Check auto start of drive on failure of AC supply (if applicable)

6. Check operation of overload relay.

7. Measure vibration.

8. Check temperature rise on body of drive after required period of continuous running

9. Measure load current and no load current (if possible)

10. Check direction of rotation.

11. Check continuity of winding.

12. Measurement of RPM.

7.7.0 PAINTING

The surface shall be free from rust, foreign adhering matters, grease etc. Two coats of rust preventing red-oxide primer and final painting of two coats as per the colour decided by the site engineer. (More details please refer Section VI scope of works). After cleaning the surface is painted with one coat of Red oxide zinc chromate primer confirming to IS 2074 and allowed to dry completely. The primer coated surface is painted with two coat of final painting of desired colour which shall be selected from IS-5.

The contractor shall paint steel fabrications at site with two (2) coats of primer followed by two (2) final of epoxy paint of shade 631 of IS:5 s tailed in section VI

7.8.0 CODES AND STANDARDS

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

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

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

IS3043	Code of practice for earthing
IS 3072	Installation and maintenance of switchgear
IS 5133	Box for enclosure of electrical equipment
IS 5216	Guide for safety procedure and practice in electrical work
IS 13947	Degree for safety procedure provided by enclosures for low voltage switchgear and control gear.
IS 5216	Guide for safety procedure and practice in electrical work
IS 800	Code of practice for use of structural steel

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

a. Indian Electricity Act and Rules framed thereunder.

b. Fire insurance regulations

c. Regulations laid down by the Chief Electrical Inspector of State and CEA

d. Regulations laid down by the Factory Inspector of State.

e. Any other regulations laid down by the authorities.

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

7.9.0 TECHNICAL REQUIREMENT FOR ITEMS SUPPLED BY THE CONTRACTOR

1. GENERAL

Equipment and material supplied shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

Equipment and materials furnished shall be complete and operative in add details.

All the accessories, fittings, supports, anchor botls etc., which form part of the equipment shall be furnished.

All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

Sample of all items shall be made available for purchaser's approval prior to supply of item to site.

2. FURRULES

a) Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter.

b) Ferrules shall be of plastic materials.

c) Numbering on the ferrules shall be engraved type with contrast color to the base. Engrave colouring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600 mm.

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

3. TAGS

a. Cables shall be provided with cable number tags for identification.

b. Cable tags shall be of durable fibre, aluminium or stainless steel sheets.

c. Cable number shall be engraved type in case of aluminium or stainless steel tags, and printed type in case of fibre sheet.

d. Tags shall be durable quality of size 60mm x 12mm with holes at both ends.

e. Samples of tags shall be approved by BHEL Engineer before delivery.

f. Tags shall be provided with non-corrosive wire of sufficient strength for taggings.

4. **FIRE STOP CABLE SEALING SYSTEM (AS APPLICABLE)**

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

7.10.0 GUIDELINES FOR ERECTION OF GI PIPES, SUPPORTS AND ACCESSORIES

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

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

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

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

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

7.10.6. Occupancy of conduits shall be greater than 40%

7.10.7. The adopter for coupling rigid GI pipe / conduits and flexible conduit shall be of aluminium or galvanized steel.

7.10.8. Transportation and storage of cable drums.

Transportation and storage of cable drums shall generally conform to the requirements of IS : 1255

7.10.9. All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.

7.10.10 The cable drums shall be transported on wheels to the place of work.

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

DATA SHEET

SPECIFIC TECHNICAL REQUIREMENTS

SUPPLY ITEMS

1.	**Ferrule**		**:**	As per Section VI
2.	**Tag**			
	a.	**Material**	**:**	Aluminium/Fiber/Stainless Steel
	b.	**Markings**	**:**	Engraving /Embossing/Printing
	c.	**Size**	**:**	As required.
3.	**Cable lugs**		**:**	Copper / Aluminium (Crimping type)
4.	**Wastage Allowance**		**:**	
		Support installation	:	1% by weight

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SECTION VII

APPENDIX – I

DECLARATION SHEET

I, hereby certify that, all the information and data furnished by me with regard to this Tender Specification No.BHEL:PSSR:SCT:1180 are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations in detail and agree to comply which the requirements and intent specifications.

I further certify that I am duly authorized representative of the under mentioned tenderer and a valid power of Attorney to this effect is also enclosed.

TENDERER'S NAME & ADDRESS

AUTHORISED REPRESENTATIVE'S
SIGNATURE WITH NAME & ADDRESS

SECTION VII

APPENDIX – II

TENDER SPECIFICATION NO BHEL:PSSR:SCT:1180

CERTIFICATE OF DECLARATION FOR CONFIRMING KNOWLEDGE ON SITE CONDITIONS

We,

hereby declare and confirm that we have visited the project site under subject, namely and acquired full knowledge and information about the site conditions. We further confirm that the above information is true and correct and we will not raise any claim of any nature due to lack of knowledge of site conditions.

TENDERER'S NAME AND ADDRESS

Place:

Date :

SIGNATURE OF AUTHORISED
REPRESENTATIVE WITH NAME & ADDRESS:

OFFICE SEAL

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector: Southern Region
474, Anna Salai, Nandanam, Chennai – 600 035.

SECTION VII

APPENDIX - III

CHECK LIST

TENDER SPECTFICATION NO, BHEL: PSSR : SCT : 1180

Tenderers are required to fill in the following details:

1.	a)	Name of the Tenderer with address	:	YES/NO
	b)	Telegraphic/Telex address	:	YES/NO
	c)	Phone (Office/Residence)	:	YES/NO
	d)	Management Structure of firm (Pvt. Ltd/Public Ltd./Partnership/Sole Proprietorship) Documentary proof For the same enclosed)	:	YES/NO
2.		Whether EMD submitted as per Tender specifications terms and Conditions	:	YES/NO
3.		Validity of offer (offer shall be kept open for acceptance for minimum six months)	:	YES/NO
4.		Whether tenderer visited the erection site and acquainted with the site conditions before quoting	:	YES/NO

SIGNATURE OF THE TENDERER

5.	Whether the following details are furnished		:	YES/NO
	a)	Previous Experience	:	YES/NO
	b)	Present assignments	:	YES/NO
	c)	organization chart of the company	:	YES/NO
	d)	Company financial statue	:	YES/NO
	e)	Incase of company, proof of Registration of the company	:	YES/NO
	f)	Memorandum & Articles of Association of company/copy of Partnership deed	:	YES/NO
	g)	Profit & Loss account for the Last 3 years	:	YES/NO
	h)	Audited Balance sheet for the Last 3 years	:	YES/NO
	i)	Income Tax clearance certificate (latest)	:	YES/NO
	j)	Solvency Certificate from a Nationalised Bank	:	YES/NO
	k)	Power of Attorney of the person Signing the tender duly attested By a Notary Public	:	YES/NO
	l)	Manpower organization chart With deployment plan at site For posting of Engineers/super Visitors and workers/labourers For satisfactory completion of Work under this specification	:	YES/NO

SIGNATURE OF THE TENDERER

6.	Whether the Tenderer is conversant with local labour laws & conditions	:	YES/NO
7.	Whether the tenderer is aware of all safety rules and codes	:	YES/NO
8.	Whether the Declaration sheet (as per appendix enclosed	:	YES/NO
9.	Time required for mobilization of of site organization and start of work	:	YES/NO
10.	Whether list of tools and Plants available with the contractor and proposed to be deployed for this work enclosed	:	YES/NO
11.	Whether all the Pages are read understood and signed.	:	YES/NO
12.	Deviations, if any Pointed out	:	
13.	Whether PF exemption No. is allotted by RPFC of your area if so, indicate number	:	YES/NO

SIGNATURE OF THE TENDERER

DETAILED BILL OF MATERIALS FOR ELECTRICAL PACKAGE (HT / LT)

RAYALASEEMA TPP : STAGE II UNIT 3 & 4 (2 X 210 MW) ELECTRICAL (HT & LT) PACKAGE

SECTION – VII APPENDIX IV A BILL OF MATERIALS WITH RELEVANT CLAUSE REFERENCE

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A	BHEL BHOPAL SCOPE				
A1	**TRANSFORMERS:**				
A1.1	**240 MVA GENERATOR TRANSFORMER** **I) Description** 240 MVA, 15.75/236 kV, Three phase, OFAF cooled, YNd1, Generator Transformer complete loose accessories like 2 Nos. of Radiator banks, on load tap changers, HV/LV/HVN bushings, bushing CTs, Turrets, conservators, cooler control cabinet, marshalling box, pipings, common KIOSK etc. Loose items like raise/lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc.shall be mounted and wired in control panel. Complete erection and integration of neutral formation and grounding, including fixing of porcelain insulators and conductors (copper bars), brazing of joints, painting of supports, repair of damaged surface, protection at brazed areas of copper bar if required, connection to ground grid etc., shall also be part of transformer erection. Approximate Dimensions and weight of transformer Shipping dimensions 7900 x 3400 x 3800 mm Overall dimensions 15430 x 8430 x 7420 mm Weight of Transformer Components Core & Winding 132000 Kg Oil 48700 Kg	1set*	1set*	2 sets*	6.3.1.1-A 6.3.1.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
	Total weight 248000 Kg Shipping weight 156000 Kg Total Oil Quantity 56000 Ltrs Ref: 3 459 0000 240 Sheet 1&2. * *Lump sum rate shall be quoted including final painting*				

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A1.2	**31.5 MVA STATION TRANSFORMER** Specification: 31.5 MVA, 220/ 7.1 KV, 3 Phase,YNdl ONAF Station Transformer with OLTC on HV side +7.5% to –12.5% in steps of (1.25 % in non auto mode, with bushing CTs radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc. Loose items like raise/lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc.shall be mounted and wired in control panel Approx.Dimensions and Weight of Transformer: a. Overall Dimensions 10000 x 5130 x 7115mm b. Shipping Dimensions 5160 x 2600 x 3600mm c. Height for untanking 8900mm a. Core & Winding 30000 kg b. Tank, Fittings 16535 kg c. Oil (26400 litres) 22970 kg d. Untanking weight 30000 kg e. Total weight 78000 kg f. Shipping weight(Gas filled) 45000 kg Ref: drg:3458 0000 198(4sh) , 3458 0000 198, Sheet 1&2. *** Lump sum rate shall be quoted, including final painting.**	1 set*	--	1 set*	6.3.1.1-B 6.3.1.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2	**HT SWITCHGEAR**				
A2.1	**Unit 3 Switchboard 3CA** 6.6 KV, indoor, metal clad, vacuum break switchgears with 2 Nos. incomer, 5 Nos. outgoing feeders , 1 No tie feeder , 3 No. PT Cubicle along with associated loose items. 3CA consists of 11 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1set*	6.3.2.1 6.3.2.2 6.3.2.3
A2.2	**Unit 4 Turbine Switchboard 4CA** 6.6 KV, indoor, metal clad, vacuum break switchgears with 2 No. incomer, 5 Nos. outgoing feeders,1 No tie feeder , 3 No. PT Cubicle along with associated loose items. 4CA consists of 11 Panels in suitable shipping sections Dimension of each Panel 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	-	1 set*	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.3	**Unit –3 Switchboard 3CB** 6.6 KV, indoor, metal clad, vacuum break switchgears with 2 No. incomer, 4 Nos. outgoing feeders, 1 No 1600 A tie feeder , 3 No. PT Cubicle along with associated loose items. 3CB consists of 10 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3
A2.4	**Unit 4 Turbine Switchboard 4CB** 6.6 KV, indoor, metal clad, vacuum break switchgears with 2 No.incomer,and 4 Nos. outgoing feeders , 1 No 1600 A tie feeder , 3 No. PT Cubicle along with associated loose items. 14CB consists of 10 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth)mm. . Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	-	1 set*	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.5	**<u>Station Switchboard 0CC</u>** 6.6 KV, indoor, metal clad, vacuum break switchgears with 2 No. 2500A incomer and 11 nos outgoing feeders, 3 No. PT Cubicle along with associated loose items. OCC consists of 16 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.6	**<u>Station Switchboard 0CD</u>** 6.6 KV**,** indoor, metal clad, vacuum break switchgears with 2 No. 2500A incomer 10 nosoutgoing feeders, 3 No. PT Cubicle along with associated loose items. 0CD consists of 15 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. . Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg Ref: Drg: 1-521-00-5-0993 **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.7	**<u>Unit 3 Boiler Switchboard 3CC</u>** 6.6 KV, indoor, metal clad, vacuum break switchgears with 1 No. incomer , 14 Nos. outgoing feeders , 1 No tie feeder , 1 No. PT Cubicle along with associated loose items. 3CC consists of 17 Panels in suitable shipping section Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. . Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.8	**<u>Unit 4 Boiler Switchboard 4CC</u>** 6.6 KV, indoor, metal clad, vacuum break switchgears with 1 No. incomer, 14 Nos. outgoing feeders , 1 No 1600 A tie feeder, 1 No. PT Cubicle along with associated loose items. 4CC consists of 17 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	-	1 set*	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.9	**<u>Unit 3 Boiler Switchboard 3CD</u>** **6.6 KV**, indoor, metal clad, vacuum break switchgears with 1 No. incomer, 13 Nos. outgoing feeders , 1no tie feeder, 1 No. PT Cubicle along with associated loose items. 3CD consists of 16 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.10	**<u>Unit 4 Boiler Switchboard 4CD</u>** **6.6 KV**, indoor, metal clad, vacuum break switchgears with 1 No. incomer, 13 Nos. outgoing feeders, 1 No tie feeder, , 1 No. PT Cubicle along with associated loose items. 4CD consists of 16 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg Ref: Drg: 1-521-00-5-1004 (TYPICAL REF FOR ALL SWITCH BOARDS) **Lump sum rate to be quoted*	-	1 set*	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.11	**CW Pump House Switchboard 0CE** **6.6 KV**, indoor, metal clad, vacuum break switchgears with 2 Nos. incomer, 10 Nos. outgoing feeders, 1 No. Trunking cum Bus PT Cubicle, 2 No. PT Cubicle along with associated loose items. 0CE consists of 17 Panels in suitable shipping sections Dimension of each Panel: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3
A2.12	**CW Pump House Switchboard 0CF** **6.6 KV**, indoor, metal clad, vacuum break switchgears with 2 Nos. incomer, 10 Nos. outgoing feeders, , 1 No. Trunking cum Bus PT Cubicle, 2 No. PT Cubicle along with associated loose items. 0CF consists of 16 Panels in suitable shipping sections Dimension: 820 (W) x 2695 (H) x2360 (Max-Depth) mm. Weight of Shipping section for 1 Panel: 1500 kg Weight of Shipping section for 2 Panels: 3000 kg **Lump sum rate to be quoted*	1 set*	-	1 set*	6.3.2.1 6.3.2.2 6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A2.13	**VFD Switchgear Panel** **3.3 KV**, indoor, metal clad, vacuum break switchgear panel 1 No. 1000A incomer fed from VFD transformer , Bus PT along with associated loose supplied items. VFD swgr consists of 2 Panels in suitable shipping sections. **Each Panel** Dimension: 820 (W) x 2300 (H) x2360 (Max-Depth). Weight of Shipping section for 2 Panel: 1250 kg **Lump sum rate to be quoted*	4 nos	4 nos	8 nos	6.3.2.1 6.3.2.2 6.3.2.3
A2.14	**EARTHING TRUCKS /BREAKERS** - 2 No. per set of panels (Feeder earthing truck-1, busbar earthing truck-1) Earthing Breakers of size 950 x 1250 x 1300 mm	8 Nos.	4 Nos.	12 Nos.	6.3.2.1 6.3.2.2 6.3.2.3
A3	**GENERATOR AND TRANSFORMER RELAY/CONTROL PANEL**				
A 3.1	**Generator Relay Panel** Generator Transformer / Station transformer Protection and control / relay Panels with associated loose supplied items such as Disturbance recorder, PC, Printer, Interconnection cable etc. No. of Panels : 8 Nos. supplied in suitable shipping sections. Size of each Panel: 1000(w) x 1000 (d) x 2230(h) mm Approx. weight of each panel : 750 kg ** Lump sum rate shall be quoted.*	1 set*	1 set*	2 sets*	6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
A3.2	**Bus Transfer scheme panel (BTS)** Bus transfer panel along with associated loose supplied items such as measuring and protective relays, meters interconnection cable indicating switches etc. Approx dimensions & Weight: each panel.: 800 x 800 x 2350 mm , 750kg ***Lump sum rate shall be quoted.***	2 Nos.	2 Nos.	4 Nos.	6.3.2.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B	BHEL JHANSI SCOPE				
B1	***TRANSFORMERS:***				
B1.1	**16 MVA UAT TRANSFORMER (3A & 3B, 4A & 4B)** Specification: 16 MVA 15.75 / 6. 9 kv, 3 Phase, ONAF, Dd0, Z=7.5%, Station Transformer with OLTC +/-10% in steps of 1.25% non auto mode, on HV Side.with bushing CTS radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc. Loose items like raise/lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. will be supplied loose, to be mounted and wired in control panel Approx Dimensions and Weight of Transformer : Overall Dimensions 6900x5400x4900 mm. Shipping Dimensions 5400x2700x2800 mm. Core & Winding 16000 kg. Tank, Fittings, radiators 14000 kg. Oil 10200 kg. Untanking weight 16000 kg. Total weight 40000 kg. Shipping weight (gas filled) 24000 kg. Total Oil Quantity (Litres) 11000 L. Ref drg: 14560050557. ** Lump sum rate shall be quoted, including final painting.*	2 sets*	2 sets*	4 sets*	6.3.1.1-C 6.3.1.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
	Final painting as per spec and approval of BHEL				
B1.2	**2500 KVA UNIT SERVICE TRANSFORMER (EPT-3A&3B , 4A&4B,)** **J) Description** 2500 KVA, 6.6KV/433 V, AN, 3 phase, 50 Hz, Dyn11, dry type cast resin Transformer, HV bushings rated for 12 kV, Marshalling Box, HV Cable box , LV Bus duct connections, other accessories etc. **K) Approximate dimensions and Weight of Transformer** Overall dimensions: 3000 x 2065 x 2900 mm. Core Coil Assembly 7500 Kg Enclosure 800 Kg Total Shipping 8300 Kg NGR : 1A, 350Ω; Size: 450 x 325 x 820mm;Weight: 45kg. ** Lumpsum rate to be quoted including final painting .*	2 sets*	2 sets*	4 sets*	6.3.1.1-D 6.3.1.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B1.3	**2000 KVA STATION SERVICE TRANSFORMER (CWT2A,2B, CLWT 2A,2B)** **L) Description** 2000 KVA,6.61KV/433 V, AN, 3 phase, 50 Hz, Dyn11, dry type cast resin Transformer, HV bushings rated for 12 kV, Marshalling Box, HV Cable box , LV Bus duct connections, other accessories etc. **M) Approximate dimensions and Weight of Transformer** **N)** Overall dimensions : 2800 x 2065 x 2750 mm **O)** Core Coil Assembly 6,200 Kg Enclosure 800 Kg Total Shipping weight 7,000 Kg NGR : 1A, 350Ω; Size: 450 x 325 x 820mm;Weight: 45kg. * *Lump sum rate to be quoted including Final painting .*	4 sets*	--	4 sets*	6.3.1.1-E 6.3.1.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B1.4	**1600 KVA UNIT SERVICE TRANSFORMER (UST3A(B) , 3B(B) & UST4A(B), 4B(B) , SST 2A,2B ,2C,2D, ACT- 2A,2B)** **P) Description** 1600 KVA, 6.6KV/433 V, AN, 3 phase, 50 Hz, Dyn11, dry type cast resin Transformer, HV bushings rated for 12 kV, Marshalling Box, HV Cable box , LV Bus duct connections, other accessories etc. **Q) Approximate dimensions and Weight of Transformer** **R)** Overall dimensions: 2800 x 2065 x 2750 mm Core Coil Assembly 5800 Kg Enclosure 800 Kg Total Shipping weight 6600 Kg NGR : 1A, 350Ω; Size: 450 x 325 x 820mm;Weight: 45kg. *Lumpsum rate to be quoted including final painting .*	8 sets*	2 sets*	10 sets*	6.3.1.1-F 6.3.1.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B1.5	**1000 KVA STATION SERVICE TRANSFORMER (UST3A(T) , 3B(T) & UST4A(T), 4B(T) , DMCWT 2A,2B)** **S) Description** 1000 KVA, 6.6KV/433 V, AN, 3 phase, 50 Hz, Dyn11, dry type cast resin Transformer, HV bushings rated for 12 kV, Marshalling Box, HV Cable box , LV Bus duct connections, other accessories etc. **T) Approximate dimensions and Weight of Transformer** **U)** Overall dimensions : 2200 x 1665 x 2500 mm **V)** Core Coil Assembly 3650 Kg Enclosure 600 Kg Total Shipping weight 4250 Kg NGR : 1A, 350Ω; Size: 450 x 325 x 820mm;Weight: 45kg. * *Lump sum rate to be quoted including Final painting .*	4 sets*	2 sets*	6 sets*	6.3.1.1-G 6.3.1.2
B2	**HT BUSDUCTS**				
B2	IP BUS DUCT (15.75 KV)				

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B2.1	**15.75 KV IP Busduct** along with support structures, LAVT Cubicle, NG Cubicle and other loose supplied items such as Seal off Bushings, CTs, Lightning Arrestor, Secondary resistor, Hot air blowing equipment, control Panel, flexible hoses from HAB System unit to Bus Duct, Control cabinet for HAB, Conduiting and wiring for space heaters, illumination, etc. CT/PT wiring & conduiting ,erection works includes making welded joints and flexible joint connection and fixing of rubber bellows & shunts etc comprising of the following a) 10000 A IP Bus Duct from 210 MW Generator to 240 MVA Three phase generator transformers, with 10000 A main run bus duct Size :Bus Round 465mm OD,15 tk,Enclosure 1000mm OD, 6.35mm tk Approximate length of all phases: 150 Meters per set b) Tap off Bus Ducts 1500A- to 2 x 16 MVA Unit Auxiliary transformers Size :BusTubular114.3mm OD,8.56 tk,Enclosure680mm OD,4.78mm tk Approximate length of all phases: 60 Meters per set **W) Dimensions & Weights of bus duct** a)App Weight of Bus duct- 32 MT. / per set d)Hot Air Blower :15120 cubicmeter / hour ,size 2600 x 1600 x 3105 mm, weight 1 ton approx Drg 35410051333 e)NG Cubicle: 2000 x 1250 x 1355 mm; 1500 kg approx. Drg 25411051169 f)LAVT Cubicle: 3 Nos., each of size 800 x 2050 x 2400 mm and weight 1400 kg each Drg 24511051 168 g)Weight of Support Structure: 14 MT (approx.) **Reference** Layout of IPB Drg No. 05410051374. ** Lump sum rate shall be quoted including final painting.*	1set*	1set*	2 sets*	6.3.4.1 6.3.4.2 6.3.4.4

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B2.2.0	**6.9 KV SP Bus ducts.** The S.P bus duct will be supplied along with support structures and other loose supplied items like seal off bushings, Flexibles, Rubber bellows, Line C.Ts etc. The work includes mounting of space heater, breather, laying of conduit and fixing, wiring and providing support and erection of overall enclosure with proper support etc Reference Drg: 05410053247 R-01 Shts 1 to 7				6.3.4.3 6.3.4.4
B2.2.1	4000Amp Busduct between Station transformer and Switch board = 600x 1600mm size. Wt: 100kg/m. Total length -15 MTR Approximate weight of Structure- 5MT	15 Mtr	-	15Mtr	
B2.2.2	2500 Amp Busduct between SWBD OCC-1 and SWBD SA of stage-1 = 450 x 1350mm size. Wt: 85kg/m.- Total length-190 MTR Approximate weight of Structure- 25MT	190Mtr	-	190 Mtr	
B2.2.3	1600 Amp Balance all Busduct sections = 450 x 1350mm size rectangular box enclosure. Wt: 75kg/m. Total length -620 MTR Approximate weight of Structure- 110MT	460Mtr	160Mtr	620 Mtr	
C	**BHEL- PEM SCOPE**				
C1.0	**NEUTRAL GROUNDING RESISTOR**				

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C1.1	Neutral Grounding Resistor (NGR), Indoor Type, 1100V, 1 A, 350 ohms, with mounting and connected accessories Size: 450 x 325 x 820 mm; Weight: 45 kg *Separate rate will not be applicable for this item as the erection of the same is covered in the erection of the respective transformers in Sl.No.B1.2, B1.3, B1.4 and B1.5*	18 Nos.	6 Nos.	24 Nos.	6.3.1.1-J 6.3.1.2
C2.0	**415V LOW VOLTAGE SWITCHGEAR/ CONTROL PANELS**				6.3.3
C2.1	**Turbine PCC (3DA/4DA)** Approximate Dimension: 13402 x 1300 x 2400 mm Approximate weight: 7500 kg	1 Set*	1 Set*	2 sets*	6.3.3
C2.2	**Turbine Valve MCC (3DD/ 4DD)** Approximate Dimension: 13737 x 850x 2400 mm Approximate weight: 10,100 kg	1 Set*	1 Set*	2 sets*	6.3.3
C2.3	**Boiler PCC (3DB)** Approximate Dimension: 15387 x 1300 x 2400 mm Approximate weight: 9,500 kg	1 Set*	--	1 Set*	6.3.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C2.4	**Boiler PCC (4DB)** Approximate Dimension: 16997 x 1300 x 2400 mm Approximate weight: 9,500 kg	--	1 Set*	1 Set*	6.3.3
C2.5	**Boiler Valve MCC (3DE/4DE)** Approximate Dimension: 20982 x 850 x 2400 mm Approximate weight: 15,100 kg	1 Set*	1 Set*	2 sets*	6.3.3
C2.6	**Station Service PCC (0DA)** Approximate Dimension: 16112 x 1300 x 2400 mm Approximate weight: 10,700 kg	1 Set*	--	1 Set*	6.3.3
C2.7	**Emergency MCC (0EA)** Approximate Dimension: 14207 x 1300 x 2400 mm Approximate weight: 10,000 kg	1 Set*	--	1 Set*	6.3.3
C2.8	Misc Service PCC (0DC) Approximate Dimension: 15222 x 1300 x 2400 mm Approximate weight: 9,600kg	1 Set*	--	1 Set*	6.3.3
C2.9	**Misc MCC (0DD)** Approximate Dimension: 14502 x 1300x 2400 mm Approximate weight: 10,500 kg	1 Set*	--	1 Set*	6.3.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C2.10	**Ventilation MCC (0DH)** Approximate Dimension: 5942 x 1300 x 2400 mm Approximate weight: 3,700 kg	1 Set*	--	1 Set*	6.3.3
C2.11	**Ventilation MCC (0DI)** Approximate Dimension: 5137 x 1300 x 2400 mm Approximate weight: 3,200 kg	1 Set*		1 Set*	6.3.3
C2.12	**Air conditioning MCC (0DG)** Approximate Dimension: 9417 x 1300 x 2400 mm Approximate weight: 6,600 kg	1 Set*	--	1 Set*	6.3.3
C2.13	**ESP & Vent MCC (3DF/ 4DF)** Approximate Dimension: 2467 x 850 x 2400 mm Approximate weight: 1,500 kg	1 Set*	1 Set*	2 Sets*	6.3.3
C2.14	**CW PCC (0DB)** Approximate Dimension: 12167 x 1300 x 2400 mm Approximate weight: 7,300 kg	1 Set*	--	1 Set*	6.3.3
C2.15	**Fire fighting MCC (0DJ)** Approximate Dimension: 9672 x 1300 x 2400 mm Approximate weight: 6,400 kg	1 Set*	--	1 Set*	6.3.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C2.16	**DMCW PCC (0DK)**** Approximate Dimension: 12302 x 1300 x 2400 mm Approximate weight: 8,200 kg	1 Set*	--	1 Set*	6.3.3
C2.17	**Air Compressor PCC (0DL)** Approximate Dimension: 9457 x 1300 x 2400 mm Approximate weight: 5,900 kg	1 Set*	--	1 Set*	6.3.3
C2.18	**Filter water P/H MCC (ODM)** Approximate Dimension: 8572 x 1300 x 2400 mm Approximate weight 5800 kg	1 Set*	--	1 Set*	6.3.3
C2.19	**ACDB –12WAY** Approximate Dimension: 1662 x 500x 2400 mm Approximate weight 1000 kg	1 Set*	--	1 Set*	6.3.3
C2.20	**ACDB –24 WAY** Approximate Dimension: 3272 x 500 x 2400 mm Approximate weight 2000 kg	1 Set*	--	1 Set*	6.3.3
C2.21	**Turbine ACDB (3DG/ 4DG)** Approximate Dimension: 4077 x 850 x 2400 mm Approximate weight: 2,500 kg	1 set*	1 set *	2 sets*	6.3.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C2.22	**Boiler ACDB (3DH/ 4DH)** Approximate Dimension: 4077 x 850 x 2400 mm Approximate weight: 2,500 kg	1 set*	1 set *	2 sets*	6.3.3
C2.23	**220V Unit DCDB (3FA/ 4FA)** Approximate Dimension: 4382 x 1300 x 2400 mm Approximate weight: 3,400 kg	1 set*	1 set *	2 sets*	6.3.3
C2.24	**220V Station DCDB (0FA)** Approximate Dimension: 4382 x 1300 x 2400 mm Approximate weight: 3,400 kg	1 Set*	--	1 Set*	6.3.3
C2.27	**Local Starter Panel**	42 Nos.	42 Nos.	84 Nos.	6.3.3

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C3.0	**BATTERY & BATTERY CHARGERS:**				
C3.1	**220 V DC Battery & Battery Charger consisting of the following:** **a) Battery banks:** 1395 AH, 208V, Plante Lead Acid battery and Float cum Boost charger panel along with fuse boxes. 104 Cells housed in 16 Nos. of single row single tier racks made of teak wood, along with inter cell connectors, inter row connector, inter bank connectors, rack insulators etc. Each charger consists float & boost charger panels, dispatched in suitable shipping sections. Total Size of Charger (FC + FCB): 3350 x 1100 x 2200 mm Approximate Weight of charger: 2000 kg Weight of each cell (with acid): 220 kg Size of each battery bank: 9776 x 2836 x 935 mm Approximate weight of batteries with rack: 24,600 kg	2 sets*	1 set*	3 sets*	6.3..8
C4.0	**HT CABLES**				6.3.10
	6.35kV/ 11kVgrade, Aluminum conductor, XLPE insulation, conductor and insulation screen, extruded PVC inner sheath, armour and extruded FRLS PVC overall sheath cables of the following sizes				6.3.10
C4.1	3C x 185 sq.mm	5,750Mtr	5,750 Mtr	11500Mtr	6.3.10

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C4.2	1C X 630 sq.mm	17000Mt	17000Mtr	34000Mtr	6.3.10
	3.3kV(Unearthed) grade Aluminium conductor, XLPE insulated, unarmoured, *FRLS PVC outer sheath, cable of the following sizes*				6.3.10
C4.3	1C x 630 sq. mm	2250Mtrs	2250 Mtrs	4500 Mtrs	6.3.10
C5.0	**HT TERMINATION KITS/ JOINTING KITS**				
	Termination kits for 6.35/11 kV grade, XLPE insulated, Aluminium conductor cables of following sizes				6.3.12.16
C5.1	1c x 630 sq. mm (Indoor Type)	20 Nos.	20 Nos.	40 Nos.	6.3.12.16
C5.2	3c x 185 sq. mm (Indoor Type)	80 Nos.	80 Nos.	160 Nos.	6.3.12.16
	6.6 kV Straight through jointing kits				6.3.12.16
C5.3	1c x 630 sq. mm	2 Nos.	2 Nos.	4 Nos.	6.3.12.16
C5.4	3c x 185 sq. mm	1 Nos.	1 Nos.	2 Nos.	6.3.12.16
	Termination kits for 3.3/3.3 kV grade, XLPE insulated, Aluminium conductor cables of following sizes				6.3.12.16
C5.5	1c x 630 sq. mm (Indoor Type)	50 Nos.	50 Nos.	100 Nos.	6.3.12.16

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C6.0	**LT POWER CABLES**				6.3.10
	1.1 kV grade, power cables with stranded Aluminum/ Copper conductor, XLPE insulated, PVC type ST2 extruded inner sheathed, galvanized steel round wire/ strip armoured overall PVC type ST2 FRLS Extruded outersheathed cables of following sizes				6.3.10
C6.1	1 C X 630 sq. mm,Al, Armoured	20000Mtr	20,000Mtr	40000Mtr	6.3.10
C6.2	1 C X 300 sq.mm, Al, Armoured	2500Mtrs	2500 Mtrs	5000 Mtrs	6.3.10
C6.3	1 C X 185 sq. mm, Al, Armoured	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
C6.4	2 C X 185 sq. mm, Al, Armoured	250 Mtrs	250 Mtrs	500 Mtrs	6.3.10
C6.5	2 C X 95 sq. mm, Al, Armoured	250 Mtrs	250 Mtrs	500 Mtrs	6.3.10
C6.6	2 C X 35 sq. mm, Al, Armoured	2000 Mtrs	2000 Mtrs	4000 Mtrs	6.3.10
C6.7	2 C X 16 sq. mm, Al , Armoured	4000 Mtrs	4000 Mtrs	8000Mtrs	6.3.10
C6.8	3 C X 185 sq. mm, Al, Armoured	10500Mtr	10500Mtrs	21000Mtr	6.3.10
C6.9	3 C X 95 sq. mm, Al, Armoured	3000 Mtrs	3000 Mtrs	6000 Mtrs	6.3.10
C6.10	3 C X 35 sq. mm, Al, Armoured	4000Mtrs	4000 Mtrs	8000Mtrs	6.3.10
C6.11	3 C X 16 sq. mm, Al, Armoured	11000Mtr	11000Mtrs	22000Mtr	6.3.10

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C6.12	3.5 C X 185 sq. mm, Al, Armoured	1500 Mtrs	1500 Mtrs	3000 Mtrs	6.3.10
C6.13	3.5 C X 95 sq. mm, Al, Armoured	2500 Mtrs	2500 Mtrs	5000 Mtrs	6.3.10
C6.14	3.5 C X 35 sq. mm, Al, Armoured	8000 Mtrs	8000 Mtrs	16000Mtr	6.3.10
C6.15	4 C X 16 sq.mm, Al, Armoured	10000Mtr	10000Mtrs	20000Mtr	6.3.10
C6.16	1 C X 630 sq. mm, Copper Armoured	1500 Mtrs	1500 Mtrs	3000 Mtrs	6.3.10
C6.17	1C X 70 sq. mm, Copper, Armoured	2500 Mtrs	2500 Mtrs	5000 Mtrs	6.3.10
C6.18	2 C X 95 sq. mm, Copper , Armoured	3000 Mtrs	3000 Mtrs	6000 Mtrs	6.3.10
C6.19	2 C X 70 sq. mm, Copper , Armoured	1000 Mtrs	1000 Mtrs	2000 Mtrs	6.3.10
C6.20	2 C X 6 sq. mm, Copper , Armoured	15000Mtr	15000Mtrs	30000Mtr	6.3.10
C6.21	2 C X 2.5 sq. mm, Copper , Armoured	24000Mtr	24000Mtrs	48000Mtr	6.3.10
C6.22	3 C X 2.5 sq. mm, Copper , Armoured	51500 Mtrs	51500 Mtrs	103000 Mtrs	6.3.10
C6.23	4 C X 2.5 sq. mm, Copper , Armoured	3000 Mtrs	3000 Mtrs	6000 Mtrs	6.3.10

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C7.0	**LT CONTROL CABLES**				6.3.10
	1.1 kV grade, control cables with stranded Copper conductor, PVC insulated, PVC type ST1 extruded inner sheathed, galvanized steel wire/ strip armoured, overall PVC type ST1 FRLS Extruded outersheathed cables of following sizes				6.3.10
C7.1	3 C X 2.5 sq. mm	45000Mtr	45000Mtrs	90000Mtr	6.3.10
C7.2	5 C X 2.5 sq. mm	50000Mtr	50000Mtr	100000 Mtrs	6.3.10
C7.3	7 C X 2.5 sq. mm	37500Mtr	37500Mtrs	75000Mtr	6.3.10
C7.4	10C X 2.5 sq. mm	25000Mtr	25000Mtrs	50000Mtr	6.3.10
C7.5	12 C X 2.5 sq. mm	37500Mtr	37500Mtr	75000Mtr	6.3.10
C7.6	16 C X 2.5 sq. mm	5,000Mtrs	5,000 Mtrs	10000Mtr	6.3.10
C7.7	20 C X 2.5 sq. mm	5,000Mtrs	5,000Mtrs	10000Mtr	6.3.10
C8.0	**CABLE TRAYS COMPLETE WITH COUPLER PLATES, FASTENERS etc.**				6.3.11.A
C8.1	Ladder type, 600 mm wide	20250Mtr	20250Mtr	40500Mtr	6.3.11.A

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C8.2	Ladder type, 450 mm wide	6150Mtr	6150 Mtrs	12300Mtr	6.3.11.A
C8.3	Ladder type, 300 mm wide	2250Mtr	2250 Mtrs	4500Mtrs	6.3.11.A
C8.4	Ladder type, 150 mm wide	1500Mtr	1500Mtrs	3000Mtrs	6.3.11.A
C8.5	Perforated Type, 600 mm wide	750 Mtrs	750 Mtrs	1500Mtrs	6.3.11.A
C8.6	Perforated Type, 450 mm wide	500 Mtrs	500 Mtrs	1000Mtrs	6.3.11.A
C8.7	Perforated Type, 300 mm wide	250 Mtrs	250 Mtrs	500 Mtrs	6.3.11.A
C8.8	Perforated Type, 150 mm wide	250 Mtrs	250 Mtrs	500 Mtrs	6.3.11.A
C8.9	Perforated Type, 100 mm wide	250 Mtrs	250 Mtrs	500 Mtrs	6.3.11.A
C8.10	Perforated Type, 50 mm wide	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.11.A
C9.0	**STRUCTURAL STEEL FOR SUPPORT**				6.3.5
C9.1	Structural Steel for fabrication of supports (ISA - 50, ISMC – 100, ISMC - 150 etc.)	60 T	60 T	120 T	6.3.5
C10.0	**GALVANIZED MS RIGID CONDUITS**				6.3.11.B
C10.1	50 mm dia Conduit	750 Mtrs	750 Mtrs	1500 Mtr	6.3.11.B
C10.2	80 mm dia Conduit	750 Mtrs	750 Mtrs	1500 Mtr	6.3.11.B
C10.3	100 mm dia Conduit	750 Mtrs	750 Mtrs	1500 Mtr	6.3.11.B
C11.0	**FLEXIBLE GI CONDUIT**				**6.3.11.B**
C11.1	50 mm dia Flexible Conduit	750 Mtrs	750 Mtrs	1500 Mtr	6.3.11.B

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C11.2	80 mm dia Flexible Conduit	750 Mtrs	750 Mtrs	1500 Mtr	6.3.11.B
C11.3	100 mm dia Flexible Conduit	750 Mtrs	750 Mtrs	1500 Mtr	6.3.11.B
C12.0	**GALVANIZED MS MARSHALLING BOX**				**6.3..9**
C12.1	6 way	3 Nos.	2 Nos.	5 Nos.	6.3..9
C12.2	12 way	2 Nos.	2 Nos.	4 Nos.	6.3..9
C12.3	36 way	2 Nos.	2 Nos.	4 Nos.	6.3..9
C12.4	48 way	2 Nos.	2 Nos.	4 Nos.	6.3..9
C13.0	**LOCAL PUSH BUTTONS STATIONS**				**6.3.9**
C13.1	Local Push Button Station (Type –A)	325 Nos.	325 Nos.	650 Nos.	6.3.9
C13.2	Local Push Button Station (Type –B)	20 Nos.	20 Nos.	40 Nos.	6.3.9
C14.0	**LIGHTINING PROTECTION SYSTEM**				6.3.6.B
C14.1	Galvanized Steel Flat, 25 X 4 mm	2500Mtrs	2500Mtrs	5000Mtrs	6.3.6.B
C14.2	20 mm dia GS Rod for Vertical Air Termination	35 Nos.	35 Nos.	70 Nos.	6.3.6.B
C14.3.A	**Test Links**	25 Nos.	25 Nos.	50 Nos.	6.3.6.B
C14.3.B	**Excavation, laying of 40mm MS round rod and weld between lightning earth electrode and test link down conductor and reconditioning of earth**	50Mtrs	50Mtrs	100Mtrs	6.3.6.B
C15.0	**ABOVE GROUND EARTHING MATERIALS**				6.3.6.A
C15.1	65 x 10 mm GS Flats	2750Mtrs	2750Mtr	5500Mtrs	6.3.6.A
C15.2	25 x 4 mm GS Flats	1250Mtrs	1250Mtrs	2500Mtrs	6.3.6.A

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C15.3	8 SWG GI Wire	2725Mtrs	2725Mtrs	5450Mtrs	6.3.6.A
C15.4	Treated Earth pit Electrical & Electronic system earthing	25sets*	20sets*	45sets*	6.3.6.A
C16.	**LT POWER (AL) cable CABLE TERMINATION**				6.3.10.13-21
C16.1	1 C X 630 sq. mm,Al, Armoured	300 Nos	300 Nos	600nos	6.3.10.13-21
C16.2	1 C X 300 sq.mm, Al, Armoured	10 Nos	10 Nos	10 Nos	6.3.10.13-21
C16.3	1 C X 185 sq. mm, Al, Armoured	28 Nos	28 Nos	56 Nos	6.3.10.13-21
C16.4	2 C X 185 sq. mm, Al, Armoured	10 Nos	10 Nos	20 Nos	6.3.10.13-21
C16.5	2 C X 95 sq. mm, Al, Armoured	4 Nos	4 Nos	8 Nos	6.3.10.13-21
C16.6	2 C X 35 sq. mm, Al, Armoured	6 Nos	6 Nos	12 Nos	6.3.10.13-21
C16.7	2 C X 16 sq. mm, Al , Armoured	22 Nos	22 Nos	44 Nos	6.3.10.13-21
C16.8	3 C X 185 sq. mm, Al, Armoured	123 Nos	123 Nos	246 Nos	6.3.10.13-21
C16.9	3 C X 150 sq. mm, Al, Armoured	2 Nos	2 Nos	4 Nos	6.3.10.13-21

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C16.10	3 C X 95 sq. mm, Al, Armoured	33 Nos	33 Nos	66 Nos	6.3.10.13-21
C16.11	3 C X 35 sq. mm, Al, Armoured	56 Nos	56 Nos	112 Nos	6.3.10.13-21
C16.12	3 C X 16 sq. mm, Al, Armoured	73 Nos	73 Nos	146 Nos	6.3.10.13-21
C16.13	3.5 C X 185 sq. mm, Al, Armoured	21 Nos	21 Nos	42 Nos	6.3.10.13-21
C16.14	3.5 C X 95 sq. mm, Al, Armoured	6 Nos	6 Nos	12 Nos	6.3.10.13-21
C16.15	3.5 C X 35 sq. mm, Al, Armoured	7 Nos	7 Nos	14 Nos	6.3.10.13-21
C16.16	4 C X 16 sq.mm, Al, Armoured	17 Nos	17 Nos	34 Nos	6.3.10.13-21
C16.17	4 C X 35 sq.mm, Al, Armoured	15 Nos	15 Nos	30 Nos	6.3.10.13-21
C16.18	1 C X 630 sq. mm, Copper Armoured	28 Nos	28 Nos	56 Nos	6.3.10.13-21
C16.19	1C X 70 sq. mm, Copper, Armoured	8 Nos	8 Nos	16 Nos	6.3.10.13-21
C16.20	2 C X 95 sq. mm, Copper , Armoured	8 Nos	8 Nos	16 Nos	6.3.10.13-21
C16.21	2 C X 70 sq. mm, Copper , Armoured	12 Nos	12 Nos	24 Nos	6.3.10.13-21
C16.22	2 C X 6 sq. mm, Copper , Armoured	22 Nos	22 Nos	44 Nos	6.3.10.13-21

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C16.23	2 C X 2.5 sq. mm, Copper , Armoured	266 Nos	266 Nos	572 Nos	6.3.10.13-21
C16.24	3 C X 2.5 sq. mm, Copper , Armoured	607 Nos	607 Nos	1214 Nos	6.3.10.13-21
C16.25	4 C X 2.5 sq. mm, Copper , Armoured	97 Nos	97 Nos	194 Nos	6.3.10.13-21
C17.0	**COMMISSIONING of the following erected by Mechanical Contractor**				6.3.15
C17.1	LT Drives- Unidirectional (including DC Drives) PEM	271 Nos.	271 Nos.	542 Nos.	6.3.15
C17.2	LT Drives- Reversible (including DC Drives) Pem	131 Nos.	131 Nos.	262 Nos.	6.3.15
C17..3	Hoists/cranes	11 Nos	11 Nos	22 Nos	6.3.15
C17.4	Control Panel for Hydrogen Dosing System	1 No.	1 No.	1 No.	6.3.15
C17.5	Control Panel for Ammonia Dosing System	1 No.	1 No.	1 No.	6.3.15
C17.6	Control Panel for Phosphate Dosing System	1 No.	1 No.	1 No.	6.3.15

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
D	**BHEL TRICHY SUPPLY**				
D1.0	**LOW VOLTAGE SWITCHGEAR/ CONTROL PANELS.**				6.3.3
D1.1	Soot Blower MCC Approximate Size: 9700 x 1000 x 2450mm; Wt : 6000 kg	1 Set*	1 Set*	2 sets*	6.3.3
D1.2	FTP Local starter panels Size: 600 x 300 x 600 mm; Wt: 60 kg each	1 No.	1 No.	2 Nos.	6.3.3
D1.3	D.C. Starter panel for Scanner air fan Size: 900 x 375 x 1120, Wt :25 kg	1 No.	1 No.	2 Nos.	6.3.3
D2.0	**JUNCTION BOXES**				
D2.1	Junction Boxes 12 way	4 Nos.	4 Nos.	8 Nos.	6.3.9
D2.2	Junction boxes 24 way	4 Nos.	4 Nos.	8 Nos.	6.3.9
D3.0	**LT POWER CABLES**				6.3.10
D3.1	3 C X 2.5 sq. mm, Cu, Armoured	25,000 Mtrs	25,000 Mtrs	50,000 Mtrs	6.3.10
D3.2	2 C X 2.5 sq. mm, Cu, Armoured	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
D.4.0	**LT CONTROL CABLES**				
D.4.1	2 C X 2.5 sq. mm, Armoured, Control Cables	2000 Mtrs	2000 Mtrs	4000 Mtrs	6.3.10
D.4.2	3 C X 2.5 sq. mm, Armoured, Control Cables	1000 Mtrs	1000 Mtrs	2000 Mtrs	6.3.10

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
E	**BHEL - RANIPET SCOPE**				
E1.0	**X) ESP CONTROL PANELS/ MCC**				
E1.1	L.T. Main Switch Board Size : 13000 x 1600 x 2400 mm Approximate Weight : 10,600 kg	1 Set*	1 Set*	2 Sets*	6.3.3
E1.2	Auxiliary Control Panel Size : 10500 x 1,600 x 2,400 mm (Incomer depth is1300mm) Approximate Weight : 8000 kg	2 Nos.	2 Nos.	4 Nos.	6.3.3
E1.3	Electronic Control Panel with Bapcon controllers Size : 700 x 650 x 2,000 mm Weight : 300 kg	32 Sets*	32 Sets*	64 Sets*	6.3.3
E1.4	IOS PC with monitor, printers and other accessories etc.	1 set*	1 set*	2 sets*	6.3.3
E1.5	Rapper Control Panel- with Rapcon controllers Size : 1000 x 650 x 2,000 mm Approximate Weight : 600 kg	2 Nos.	2 Nos.	4 Nos.	6.3.3
E1.6	Ash level indicator, along with accessories like 15 m each of flexible conduit, cable, wire, electronic unit and probe assembly Size of ALI: 900 x 100 x 100 mm; 10 kg each	64 Sets*	64 Sets*	128 Sets*	6.3.15

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
E2.0	**Heating elements**				6.3.15
E2.1	Testing and Termination and dressing of Heating Elements for Hopper	768 Nos.	768 Nos.	1536 Nos.	6.3.15
E2.2	Testing Heating elements for support insulator heater	128 Nos.	128 Nos.	256 Nos.	6.3.15
E2.3	Testing Heating elements for shaft insulator heater	32 Nos.	32 Nos.	64 Nos.	6.3.15
E2.4	Testing Thermostats for hopper heaters.	32 Nos.	32 Nos.	64 Nos.	6.3.15
E2.5	Testing Thermostat for support insulators	4 Nos.	4 Nos.	8 Nos.	6.3.15
E3.0	**Junction Boxes/ Local Start Stop Push Buttons**				6.3.3
E3.1	Local Start Stop Push Buttons (for Rapping Motors) Size: 160 x 150 x 200 mm; approximate wt 4 kg each	68 Nos.	68 Nos.	136 Nos.	6.3.3
E3.2	Power Junction Boxes for hopper heaters/ support insulator heaters/ shaft insulator heaters Size: 500 x 300 x 150 mm; approximate wt 50 kg per JB	44 Nos.	44 Nos.	88 Nos.	6.3.3
E3.4	Control Junction Boxes for hopper thermostat, start stop PBs, ALI Size: 500 x 300 x 150 mm; approximate wt 5 kg each	20 Nos.	20 Nos.	40 Nos.	6.3.3
E4.0	**CABLE TRAYS COMPLETE WITH COUPLER PLATES, FASTENERS**				6.3.11.A
E4.1	Ladder type 600 mm wide	750 Mtrs	750 Mtrs	1500Mtrs	6.3.11.A
E4.2	Ladder type 450 mm wide	750 Mtrs	750 Mtrs	1500Mtrs	6.3.11.A
E4.3	Ladder type 300 mm wide	500 Mtrs	500 Mtrs	1000Mtrs	6.3.11.A

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
E4.4	Ladder type 150 mm wide	2000Mtrs	2000Mtrs	4000mtrs	6.3.11.A
E5.0	**LT POWER CABLES** 1100 V grade, XLPE insulated, FRLS outer sheathed, Armoured, Al cables				6.3.10
E5.1	3 C X 10 sq. mm	4750Mtrs	4750Mtrs	9500Mtrs	6.3.10
E5.2	3 C X 35 sq. mm	550 Mtrs	550 Mtrs	1100Mtrs	6.3.10
E5.3	2 C X 120 sq.mm	10500Mtr	10500Mtrs	21000Mtr	6.3.10
E5.4	3 .5 C X 120 sq. mm	500 Mtrs	500 Mtrs	1000Mtrs	6.3.10
E6.0	**LT CONTROL CABLES** 1100 V grade, PVC insulated, armoured, PVC outer sheathed, Cu cables				6.3.10
E6.1	2 C X 2.5 sq. mm	7000 Mtrs	7000 Mtrs	14000Mtr	6.3.10
E6.2	3 C X 2.5 sq. mm	10500Mtr	10500Mtrs	21000Mtr	6.3.10
E6.3	7 C X 2.5 sq. mm	2000 Mtrs	2000 Mtrs	4000 Mtrs	6.3.10
E6.4	10C X 2.5 sq. mm	7750 Mtrs	7750 Mtrs	15500Mtr	6.3.10
E7.0	**EARTHING MATERIALS**				6.3.6A
E7.1	GI Flat 50 x 6 mm	1300 Mtr	1300 Mtr	2600 Mtr	6.3.6A
E7.2	GI Flat 30 x 5 mm	500 Mtr	500 Mtr	1000 Mtr	6.3.6A

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
E7.3	GI wire 8 SWG 3.15 mm dia	6000 Mtr	6000 Mtr	12000Mtr	6.3.6A
E8.0	**STRUCTURAL STEEL FOR SUPPORT**				6.3.5
E8.1	(ISMC 100, ISA 50x50x6 etc.)	2.0 MT	2.0 MT	4.0 MT	6.3.5
E9.0	**LT POWER CABLE TERMINATION**				6.3.12.16
E9.1	3C x 2.5 sqmm CU	256 Nos	256 Nos	512 Nos	6.3.10.13-21
E9.2	3C x 10 sqmm	40 Nos	40 Nos	80 Nos	6.3.10.13-21
E9.3	3C x 35 sqmm	10 Nos	10 Nos	20 Nos	6.3.10.13-21
E9.4	2C x 120 sqmm	128 Nos	128 Nos	256 Nos	6.3.10.13-21
E9.5	3.5C x 120 sqm	20 Nos	20 Nos	40 Nos	6.3.10.13-21
E10.0	**COMMISSIONING** ***of the following erected by Mechanical Contractor*** **)**				6.3.15
E10.1	LT Drives of ESP/Ranipet	68 Nos.	68 Nos.	136 Nos.	6.3.15
E10.2	Hoists/cranes/monorail	2 Nos.	2 Nos.	4 Nos.	6.3.15
E10.3	**ESP Transformer** Commissioning of **High voltage rectifier transformer –95 kv, 800Ma** The scope of work includes oil filtration, sample testing for dielectric strength, PPM etc., calibration of WTI, Bucholz relay etc Approximate Oil Quantity per transformer: 500 litres *Lump sum rate to be quoted including Final painting*	32 Nos.	32 Nos.	64 Nos.	6.3.1.1.I 6.3.15.2

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
F.	**BHEL EDN SCOPE OF SUPPLY**				
F1.0	DIGITAL AUTOMATIC VOLTAGE REGULATOR				
F1.1	Digital AVR consisting of 1 No. Regulation cubicle, 1 No. Thyristor cubicle and 1 No. Field suppression cubicle. Overall size 3050 x 750 x 2295 mm Approximate wt: 1000 kg	1 set*	1 set*	2 sets*	6.3.2.3
F2.0	**VFD FOR ID FANS**				
F2.1	**VFD transformers** 1600 KVA, 6.6/ 1.25 KV, 3f, ONAN, Dd0/Dyn11, dry type cast resin type transformer with HV, LV cable boxes, etc. Approximate dimensions Overall dimensions : 3000 x 2200 x 2665 mm Weight of Transformer Components Core Coil Assembly 5600 Kg Enclosure 900 Kg Total Shipping weight 6500 Kg * *Lump sum rate to be quoted including Final painting.*	4 sets*	4 sets*	8 sets*	6.3.1.1-H

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
F2.2	**DC Air cooled Reactor** Floor/channel mounting type 1.8 KV grade, 7.0 mH, 800 A rated air cooled DC reactor housed in 3mm thick Aluminium cubicle with suitable input/output terminals Dimension: 2350 x 2250 x 1975 mm , Weight: 1350 kg	4 sets*	4 sets*	8 sets*	6.3..7
F2.3	**LCI Drive Panel:** comprising Control and Excitation Panel, Fan and Filter Panel with air duct for exhausting air, Bridge Panels-1&2, AC Input Panel and AC Output Panel. Size: 4182 x 1100 x 2420 mm; Weight: 5000 kg, dispatched in suitable shipping sections	4 sets*	4 sets*	8 sets*	6.3..7
F2.4	**Control Panel for VFD Drives** Size: 800 x 1100 x 2330 mm; weight: 400 kg	2 Nos.	2 Nos.	4 Nos.	6.3..7
F2.5	**Contactor Panel for VFD Drives** Size: 750 x 1100 x 2330 mm; weight: 400 kg	4 Nos.	4 Nos.	8 Nos.	6.3.7
F2.6	**MMI for VFD-**Standalone PC with monitor, printer, power distribution box, computer table, interconnection power and control cables etc. for all the 4 Channels. The scope of work includes installation, integration of the system and testing	1 set*	--	1 set*	6.3.7

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
F3.0	**LT POWER CABLES**				6.3.10
F3.1	3C X 95 sq. mm, Al, Armoured	650 Mtrs	650 Mtrs	1300 Mtrs	6.3.10
F3.2	3C X 25 sq. mm, Al, Armoured	3280 Mtrs	3280 Mtrs	6560 Mtrs	6.3.10
F3.3	2C X 2.5 sq. mm, Cu, Armoured	600 Mtrs	600 Mtrs	1200 Mtrs	6.3.10
F4.0	**LT CONTROL CABLES**				6.3.10
F4.1	2 C X 1.5 sq mm, Cu, Armoured	2560Mtrs	2560Mtrs	5120Mtrs	6.3.10
F4.2	4 C X 1.5 sq mm, Cu, Armoured	580 Mtrs	580 Mtrs	1160Mtrs	6.3.10
F5.0	**SCREENED CABLES**				
	PVC/FRLS, Armoured, Type 'F' (individually and overall shielded) cables				6.3.10
F5.1	2P x 0.5 sqmm cable	800 Mtrs	800 Mtrs	1600Mtrs	6.3.10
F5.2	4P x 0.5 sqmm cable	3300Mtrs	3300Mtrs	6600Mtrs	6.3.10
F5.3	12P x 0.5 sqmm cable	1100Mtrs	1100Mtrs	2200Mtrs	6.3.10
	Type 'G' (Overall shielded) Cables				6.3.10
F5.4	2P x 0.5 sqmm cable	1680Mtrs	1680Mtrs	3360Mtrs	6.3.10
F5.5	4P x 0.5 sqmm cable	2380Mtrs	2380Mtrs	4760Mtrs	6.3.10
F5.6	8P x 0.5 sqmm cable	2440Mtrs	2440Mtrs	4880Mtrs	6.3.10
F5.7	14P x 0.5 sqmm cable	800 Mtrs	800 Mtrs	1600Mtrs	6.3.10

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
F6.0	**LT POWER CABLE TERMINATION**				6.3.10.13-21
F6.1	3C X 95 sq. mm, Al, Armoured	8 Nos.	8 Nos.	16 Nos.	6.3.10.13-21
F6.2	3C X 25 sq. mm, Al, Armoured	12 Nos.	12 Nos.	24 Nos.	6.3.10.13-21
F6.3	2C X 25 sq. mm, Al, Armoured	12 Nos.	12 Nos.	24 Nos.	6.3.10.13-21
F6.4	2C x 2.5 sq. mm, Cu, Armoured	48 Nos.	48 Nos.	96 Nos.	6.3.10.13-21
F7.1	Generator Control panel (GCP) 1370 (W) x 1000 (D) x 2344 (H), weight approx 1300 Kgs	1No	1no	2Nos	
F7.2	Unit auxiliary control board (UAB) 2278 (W) x 100 (D) x 2344 (H) Weight approx 1600 Kgs	1no	1no	2nos	
F7.3	Station auxiliary control board (SAB) 2370 (W) x 1000 (D) x 2344 (H) weight approx 1600 kgs	1 no	-	1 No	
F7.4	3C x 50 Sq mm screened copper cable	300 metres	300metres	600 metres	
F7.5	3C x 2.5 sq mm screened copper cable	150 metres	150 metres	300 metres	

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
G.	**BHEL-HARDWAR SCOPE**				
G.1.0	**STARTER CABINET WITH RESISTANCE**				6.3.3
G.1.1	D.C. Starter Cabinet with Resistance box for DC Seal Oil Motor Approximate size of s panel.: 1000 x 800 x 2200 mm; Wt :450 kg Approximate size of resistance box.: 600 x 600 x 500 mm; Wt: 200 kg	1Set*	1 set*	2 sets*	6.3.3
G.1.2	D.C. Starter Panels For EOPs , JOP Approximate size & Wt.: 800 x 800 x 2280 mm; 450 kg each	2 Sets*	2 sets*	4 sets*	6.3.3
G.1.3	Lub Oil Purification Equipment Panel Approximate size: 1000 x 800 x 2280 mm;	1Set*	1 set*	2 sets*	6.3.3
G.2.0	***COMMISSIONING of the following erected by Mech contractor***				6.3.15
G.2.1	Exciter drier/heater	1 set*	1 set*	2 sets*	6.3.15
G.2.2	Generator Air Drier	1 set*	1 set*	2 sets*	6.3.15
G3.1	**210 MW Generator** H.V. testing, meggering of Bushings & Accessories, resistance measurement, meggering including dry out of generator.	1 No.	1 No.	2 Nos.	6.3.15
G3.2	**Motors**				6.3.15
G3.2.1	**6.6 KV Motors** (BFP, PA Fan ,ID Fan ,CE Pump, Mills, FD Fan , **)**	18 Nos.	18 Nos	36 nos	6.3.15

Sl No	BOM Ref No	Description	Quantity
		PROVISIONAL ERECTION RATES TO BE QUOTED FOR FOLLOWING OPTIONAL ITEMS	
1.	H.0.1	Filtration of Transformer oil	Per kilo litres
2.	H.0.2	Providing Aluminium welding including all works such as cutting, chamfering etc. incidental to the job, along with all tools & tackles, machinery, consumables all inclusive.	
3.	H.0.3	Aluminium conductor of thickness 8 mm to 15 mm	Per mtr run
4.	H.0.4	Aluminium enclosure of thickness 6mm to 8mm	Per mtr run
5.	H.0.5	Aluminium enclosure of thickness below 6 mm	Per mtr run
6.	H.1.1.	GI pipe 150 mm ϕ	(per m)
		CABLES (Laying &Termination)	
		1.1 kV, Unarmoured Al, PVC/FRLS Power Cable	
7.	H.1.2.1	2 C x 6 sq. mm	(per m)
8.	H.1.2.2	2 C x 10 sq. mm	(per m)
9.	H.1.2.3	4 C x 6 sq. mm	(per m)
10.	H.1.2.4	4 C x 10 sq. mm	(per m)
		1.1 kV, Unarmoured Cu, PVC/FRLS Power Cable	

Sl No	BOM Ref No	Description	Quantity
		PROVISIONAL ERECTION RATES TO BE QUOTED FOR FOLLOWING OPTIONAL ITEMS	
11.	H.1.2.5	2 C x 10 sq. mm	(per m)
12.	H.1.2.6	5 C x 4 sq. mm	(per m)
13.	H.1.2.7	5 C x 6 sq. mm	(per m)
		1.1 kV, Unarmoured Cu, PVC/FRLS Control Cable	
14.	H.1.2.8	2 C x 2.5 sq. mm	(per m)
15.	H.1.2.8	24 C x 2.5 sq. mm	(per m)
16.	H.1.2.9	2 C x 4 sq. mm	(per m)
17.	H.1.2.10	5 C x 4 sq. mm	(per m)
18.	H.1.2.11	10 C x 1.5 sq. mm	(per m)
19.	H1.2.12	19 C x 1.5 sq. mm	(per m)
20.	H.1.2.13	27 C x 1.5 sq. mm	(per m)
21.	H.1.3	Excavation of earth in any type of soil and refilling earth	(per cu. m)

GENERAL NOTES:

THE SCOPE OF WORK SPECIFIED UNDER CLAUSE N0 6.3 FOR VARIOUS ITEMS / EQUIPMENTS / HARDWARE SHALL ALSO COVERS THE FOLLOWING COMMON CLAUSE

- REFER CLAUSE 6.3.12 FOR PAINTING
- REFER CLAUSE 6.3.14. FOR CIVIL WORKS
- REFER CLAUSE 6.3.13 FOR TESTING AND CALIBRATION
- REFER CLAUSE 6.3.16 FOR PRE COMMISSIONING