TENDER SPECIFICATION

BHEL: PSSR: SCT: **1336**

FOR

Handling at Site Stores / Storage yard, Transportation to Site of Work, Erection, Testing and Commissioning of HT and LT Electrical Package for Unit – 5 -1x 210 MW set, Stage III,

at

Rayalaseema Thermal Power Project

(Muddanur) V.V.Reddy Nagar,
Kalamalla Post,Cuddapah Dt, AP

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.

INDEX SCT: 1336

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: 1336

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 Unit – 5 of 210 MW set, Stage III, RTPP Muddanur.

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

You are requested to go through the tender documents, and GCC Booklet and offer your most competitive 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 lakh only)** in the form Demand Draft drawn in favour of M/s.Bharat Heavy Electrical Limited Chennai – 35.

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

Bids with Deviations from the tender conditions will be rejected.

The completed quotations shall reach the office of the under signed on or before 08.04.09 **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 bidders 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

ADDITIONAL GENERAL MANAGER / CONTRACTS

Place : Chennai -35

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

- This Tender document is not transferable

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. Organization 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

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 Terms 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 LOIs, Work Order, Work Completion certificate, Financial statements, etc, pertaining to the experience indicated in the Qualifying Requirement as given below**:

14. QUALIFICATION REQUIREMENT

a. The bidder should have completed erection, testing and commissioning of HT/LT Electrical works consisting of HT Transformer of minimum rating 90 MVA and other related Electrical works like HT Bus ducts, HT switch gear, cabling, trays, etc during last seven years. The bidder should possess valid licence for High Voltage electrical Installation."

b The bidders should have a minimum average financial turn over of **Rs 155 Lakhs** in last three financial years ending on 31st March 2008.

The bidder should have earned profit in any one of the last three financial years ending on 31.03.2008 and should have positive net worth as on 31.03.2008.

Bidder should submit audited balance sheet and profit & loss account of the company for last three years ending on 31.03.2008 in support of above requirement.

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

d. 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 IN 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 Additional 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 Lakh 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.

Additional 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: 1336

Description	EMD
Handling at Site Stores / Storage yard, Transportation to Site of Work, Erection, Testing and Commissioning of HT and LT Electrical Package for Unit – 5 of 210 MW set, Stage III, at Rayalaseema Thermal Power Project (Muddanur) V.V. Reddy Nagar, Kalamalla Post, Cuddapah District, Andhra Pradesh.	**Rs. 2,00,000/-** **(Rupees Two Lakh only)**

Cost of Tender Documents (Including all Taxes)	:	**Rs.1040/-**	
Sale Starts on	:	19.03.2009	
Sale closes on	:	07.04.2009	
Due date and Time for Submission	:	08.04.2009	**15.00 Hrs**.
Date and time for opening of Technical Bids	:	08.04.2009	**15.30 Hrs**.

QUALIFICATION REQUIREMENT

a. The bidder should have completed erection, testing and commissioning of HT/LT Electrical works consisting of HT Transformer of minimum rating 90 MVA and other related Electrical works like HT Bus ducts, HT switch gear, cabling, trays, etc during last seven years. The bidder should possess valid licence for High Voltage electrical Installation."

b The bidders should have a minimum average financial turn over of **Rs 155 Lakhs** in last three financial years ending on 31st March 2008.

The bidder should have earned profit in any one of the last three financial years ending on 31.03.2008 and should have positive net worth as on 31.03.2008.

Bidder should submit audited balance sheet and profit & loss account of the company for last three years ending on 31.03.2008 in support of above requirement.

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

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

Interested parties can get the Tender documents from the office of the Additional General Manager / Contracts on all working days (except Second and last Saturdays) by remitting the cost of tender documents either by Cash (10.00 AM- 3.30 PM) or A/c Payee Demand Draft (10 AM- 4.30 PM) drawn in favour of M/s. Bharat Heavy Electricals Limited, Chennai - 600 035. Money order, Cheques and Postal Orders will not be accepted.

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 tenders without assigning any reason there for.

Please visit our web site at www.bhel.com for corrigendum, if any issued after publication of this Tender notice.

Downloaded Tender documents should be submitted along with demand draft for the requisite amount towards the cost of Tender documents.

ADDL. GENERAL MANAGER/CONTRACTS

TENDER SPECIFICATION: BHEL: PSSR: SCT: 1336

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

Additional 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: 1336** 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 Lakh 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

SCT 1336 –RTPP MUDDANUR-STG & AUXILIARIES

PROJECT INFORMATION

1.0 GENERAL

1.1	Authority	:	APGENCO
1.2	Name of Project	:	Rayalaseema Thermal Power Project St.IiI (1 x 210 MW Units), Muddanur Unit-5 1x 210 MW
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 Meters 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 Provisions 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 unit is handed over as specified in detail in clause.

3.2.0 FACILITIES TO BE PROVIDED BY BHEL:

3.2.1 OPEN SPACE

Minimum Open space for building of 1 No temporary office / store shed will be provided free of cost. Contractor has to make his own arrangements for labour colony, including Electricity and water for the labour colony.

3.2.2 ELECTRICITY

For construction purpose and for contractor's office and store sheds electricity **will be provided at one single point free of charges**. Further distribution shall be arranged by the contractor at his own cost including supply of energy meter with calibration certificate.

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

Before connecting any equipment the contractor shall ensure that it is rated for the correct voltage to which it is being connected and the equipment is not likely to cause a fuse blow out.

The contractor shall endeavour to minimize the current consumption as far as possible and avoid wastage.

3.2.3 WATER

For construction purpose, water will be provided at one point free of cost nearer to the project site. Further distribution shall be arranged by the contractor at his own cost. For drinking purpose the contractor has to make his own arrangement at his cost.

3.2.4 TOOL AND TACKLES

All the Tools & Plants and instruments required for the complete erection of components shall be arranged by the contractor.

EOT crane shall be provided by BHEL free of hire charges,on sharing basis, for shifting of Panels. Contractor has to arrange operator at his cost.

Propriety type of instrument, supplied along with the equipment will be provided by BHEL free of charge.

75 T / 18 T crane – 1 no fuel and operator to be arranged by contract at his lost.

3.2.5 CONSUMABLES

All consumables, electrodes including Oxygen/ Acetylene, Argon , Gases, paints etc., shall be arranged by the contractor at his own cost.

3.3.0 FACILITIES TO BE PROVIDED AND DEVELOPED BY THE 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 this purpose.

3.3.2 WATER DISTRIBUTION

Distribution of water for various work fronts from the single point shall be arranged by the contractor at his cost.

3.3.3 ELECTRICITY DISTRIBUTION

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. Any duty, deposit involved in getting the electricity shall be borne by the bidder. As regards contractors office shed also all such expenditure shall be borne by the contractor. Necessary meters for recording consumption of power for cost calculation purpose and maintenance of the same during execution period shall be contractor's responsibility.

3.3.4 POSSESSION OF GENERATORS

As there are bound to be interruptions in regular power supply power cut/load shedding in any construction site due to inherent power shortage in State , suitable extension of time if found necessary only be given on this account 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.

3.3.5 LIGHTING FACILITIES

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 REQUIRMENT

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, pipelines, cable etc. shall be dismantled and levelled 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 BHEL will undertake such work and the cost of the same will be recovered from the Contractor including overhead charges. The decision of BHEL. Engineer in this regard is final.

3.4.0 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 reason 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.

3.5.0 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 etc. On receipt of the electrodes at site, it shall be subject to inspection and approval of BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry.

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

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

3.6.0 TOOLS & TACKLES

3.6.1 All T & P required for the satisfactory execution of work shall be arranged by contractor at his cost, except the items specifically indicated as provided by BHEL.

3.6.2 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.

3.6.3 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.

3.6.4 All the T & P arranged by contractor including electrical connections wherein required shall be reliable / proven / tested and necessary test certificate to be submitted as per statutory rules of the State / Central Government in force from time to time.

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 his cost.

3.7.0 SUPERVISORY STAFF AND WORKMEN

3.7.1 The Contractor shall deploy experienced Engineers, Supervisors all the skilled workmen like 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 stores/storage yard to erection site, transportation, erection, testing and commissioning contemplated under this specification. Only fully trained and competent men with previous experience on the job shall be employed. They shall hold valid certificates wherever necessary.

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.

3.7.2 The supervisory staff employed by the contractor shall be qualified (Engineers - Graduates in Engineering and Supervisors - Diploma Holders) 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 BHEL's client.

3.7.3 The Contractor shall furnish daily labour report showing by classification the number of employees engaged in various categories of work and a progress report of work as required by BHEL Engineer. The contractor shall also give a summary report at the end of the month and plan of deployment for the consequent month as per the plan of activities as required by BHEL, to meet the overall contract requirement.

3.7.4 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 and other contractor's personnel working in site and proceed in a manner that shall not delay or hinder the progress of work as a whole.

3.7.5 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. Wherever finish or tolerances are not specified in drawings/documents, BHEL Engineers instruction are taken as final.

3.7.6 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.

3.7.7 It is the responsibility of the bidder to engage his workmen in shifts or on overtime basis during erection, commissioning and testing period for achieving the target set by BHEL . The contractor's quoted rate shall include all these contingencies.

3.7.8 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 the erected components etc. The contractor shall make the same good at his own expense or in default, BHEL may cause the same to be made 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 CIVIL WORKS

3.8.1 Foundations of all equipments and plants and necessary civil works shall beprovided by BHEL. The dimensions of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further top elevation of foundations shall be checked with respect to bench mark etc. All minor adjustments upto 25 mm of foundation level, dressing, chipping of foundation surface enlarging the pockets in foundations and grouting of equipments etc. as may be required for the erection of equipment/plants shall be carried out by the Contractor. All the materials like cement, sand, gravel etc. and cleaning consumables shall also be arranged by the contractor at his cost.

The required special cement like CONBEXTRA-GP2 and SHRINKOMP N 30 etc or its equivalent grade cement for grouting of columns, equipments etc. shall be arranged by the contractor at their cost. The contractor should also arrange required nos. of mixing machines and vibrators at their cost.

3.8.2 The contractor shall ensure perfect matching of packer plates with foundation by dressing the foundation and between the packer plates and the base plate of structural column/equipment to the satisfaction of BHEL Engineer. Machining/matching of packer shall be carried out by the Contractor at his own cost.

3.8.3 The contractor shall arrange for grouting of foundation bolt holes of equipment and final grouting of equipment as per the drawings / specification or as advised by the Engineer or BHEL after preparing the foundation surface for grouting.

3.8.4 Contractor has to carry out the grouting as per the work instructions for grouting available at site.

3.8.5 The contractor at his cost shall arrange for grouting of anchor points of T & P issued to him and also grouting of winches or any other supports required for T & Ps. Necessary grout materials are to be arranged by the contractor at his cost.

3.9.0 SCOPE OF MATERIAL HANDLING AND SITE STORAGE AND OTHER RESPONSIBILITIES

3.9.1 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 materials 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.

3.9.2 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.

3.9.3 It shall be contractor's responsibility to arrange necessary cranes/tractors, trailer or trucks/slings/tools and tackles/labour including operators Fuel lubricants etc., for loading from storage yard 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.

3.9.4 All equipment so used by contractor shall be of proven quality and safe in operation as approved by BHEL site Engineers from time to time.

3.9.5. 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.

3.9.6 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 and maintain records.

3.9.7 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.

3.9.8 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.

3.9.9 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.

3.9.10 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.

3.9.11 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.

3.9.12 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.

3.9.13 The work covered under this scope of work is of highly sophisticated nature requiring best quality / precision workmanship engineering and construction management. He 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.

3.9.14 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.

3.9.15 The contractor shall take all reasonable care to protect the materials and work till such time the erected equipment has been taken over by BHEL/their client. Wherever 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.

3.9.16 The contractor shall be responsible for taking all safety precautions during the construction and keeping 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 services. 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.

3.9.17 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 and erection. The history cards for major equipments to be maintained by the contractor.

3.9.18 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.

3.9.19 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.

3.10.0 PRESERVATION OF COMPONENTS

3.10.1 It shall be the responsibility of the contractor to apply preservative 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 the contractor at his cost.

3.10.2 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.

3.10.3 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.

3.10.4 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 other consumables like painting brush, emery paper, cotton waste, cloth etc. have to be arranged by the contractor at his 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.

3.11.0 DRAWINGS AND DOCUMENTS

3.11.1 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.

3.11.2 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.

3.11.3 The data furnished in various appendices 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.

3.11.4 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.

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

3.12.0 SITE CLEANLINESS AND SAFETY REQUIREMENTS

3.12.1 Contractor shall strictly follow all safety regulations/conditions as per general conditions of contract booklet enclosed with this tender, including specification of Health, Safety and Environment (HSE) management of customer / consultant.

3.12.2 Non-conformity of safety rules and safety appliances will be viewed seriously and the BHEL has right to impose fines on the contractor as under:

SNo	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/-

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

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

3.13.0 PROGRESS OF WORK

3.13.1 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.

3.13.2 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.

3.13.3 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.

3.13.4 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.

3.13.5 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.

3.13.6 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.

3.13.7 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.

SPECIFIC REQUIREMENTS FOR ISO 9001 - 2000

3.14.0 IMPORTANT NOTE

Contractors shall ensure that all their Staff/Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9002 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 contractor or used on loan, are calibrated by the authorized agencies and the valid calibration certificate will be availableith 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 contractor for the non-conformances if any, observed and pointed out by BHEL.

3.15.0 INSPECTION / QUALITY ASSURANCE / QUALITY CONTROL STATUTORY INSPECTION

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

3.15.2 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.

3.15.3 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.

3.15.4 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.

3.15.5 Approval Given by Customer/BHEL for welding, results tests etc. shall also be recorded in the log book.

3.15.6 All the Electrical/Technical Measuring and Testing Instruments / Gauges, Feeler Gauges, Height 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, Levelling, 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 of BHEL Engineer.

3.15.7 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.

3.16.0 STAGE INSPECTION BY FES / QA ENGINEERS

3.16.1 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. Contractor shall arrange all labour, Tools and Tackles, etc. for such stage inspections free of cost.

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

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

3.16.4 Any major Rectification or Major Repair / Major Rework 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.

3.17.0 STATUTORY INSPECTION

The scope includes getting the Approvals from the statutory authorities (Like Electrical Inspector and Labour Officers). This includes Arranging for Inspection Visits of Inspector Periodically as per BHEL Engineer's Instructions, Submitting Documents, Radiographs, Etc. and following up the matter with them.

All fees connected with the contractors for Testing his Welders/Men / Works and Testing, Inspection, calibrating his instruments and equipments, shall be paid by the contractor. It shall be contractor's 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 be 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.

3.18 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 ⑨ 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 fulfil required electrical safety aspects as per relevant BIS 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 to2 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 authorise 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 electric 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 remnant 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 HCE 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 UNIT 5 (1 X 210 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, erecting, checking, carrying out statutory tests as required, pre-commissioning, commissioning & post-commissioning activities upto trial 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 and all type of manpower etc. The installation and commissioning of all the electrical equipments/items shall conform to the technical requirements specified elsewhere in the tender.

6.1.1 It is not the intent to specify herein all details of material. Any item related to this work not covered, but necessary to complete the system will be deemed to have been included in the scope of the work.

6.1.2 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.

6.1.3 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 similar jobs or for any reasons whatsoever.

6.1.4 On completion of erection works, the contractor shall arrange for joint inspection for the erection completion with minimum seven (7) days advance notice. Any defect pointed out during such inspection shall be promptly rectified by the contractor.

6.1.5 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.

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

6.1.7 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 stations 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 and the same shall be deemed to be included in the scope of work. Payment towards such works shall be as per clauses referred elsewhere.

6.1.8 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.

6.1.9 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. The contractor shall take delivery of items/materials, and consumables after getting approval of engineer / customer in the prescribed indent forms of BHEL / customer.

6.1.10 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.

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

6.1.12 The contractor shall transport the materials to erection site/ assembly yard etc. by the prescribed route without disturbing and causing damage to other works in the most professional manner. All items, Hardware, etc. shall be stored in appropriate manner as per BHEL's instructions.

6.1.13 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.

6.1.14 The 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 remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc. shall be returned to the BHEL stores / customer's stores by the contractor.

6.1.15 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

6.1.16 The contractor shall make arrangements for safe custody, watch and ward of equipment that has been handed over to him till they are fully erected, tested and commissioned till the completion of contract period. The contractor shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor’s construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

6.1.17 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.

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

6.1.19 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.

6.1.20 The contractor shall have valid **ELECTRICAL CONTRACTOR LICENSE** to carry out the Electrical works. All necessary certificates and licenses required to carryout this work are to be arranged by the contractor expeditiously at his cost.

6.1.21 The contractor shall arrange statutory inspection and obtain necessary certificates for his installation works at his cost. Any modification work required by inspector shall be attended by the contractor at his cost.

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 item 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.

6.1.23 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.

6.2.0 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 Generator and Transformer protection Panels, DAVR and other Electrical protection and control panels

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

6.2.5 Erection of Cable Trays & accessories and Tray supports.

6.2.6 Erection and commissioning of VFD systems

6.2.7 Erection and commissioning of Battery & Battery Charger panels.

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

6.2.9 Laying and termination of HT/ LT cables

6.2.10 Supply (if applicable) and Installation of cables glands, lugs, ferrules, tag plates, and cable dressing materials.

6.2.11 Supply and Installation of items for underground cable installation like cable markers, cable joint markers etc. (if applicable)

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

6.2.13 Supply (as applicable) and installation of Lightning protection system.

6.2.14 Installation of rubber floor mats for HT/ LT panels.

6.2.15 Supply of all consumables required for installation, as detailed elsewhere in the contract.

6.2.16 Painting of all steel fabricated items, including supply of paints.

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

6.2.18 **The scope of work in general covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores/ working yard, keeping in safe custody in contractor's stores, pre-assembly, checking, erection, testing and commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, ferrules, lugs (specific sizes), specific type of fasteners, paints and its consumables, Deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipments, Testing instruments (excepting proprietary type instruments), returning of un-used materials / items to 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 transformers shall be installed inside MCC room.

A) 240 MVA GENERATOR TRANSFORMER:

Description: The Generator Transformer shall be of 240 MVA, 15.75/236 kV, 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 KIOSK etc. Loose items like raise/lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps,

Accessories: PRV-1, Drain valve2, Cooler control cabinet-1, inlet-2 & out let valves-1 (1 each), 36kv22kVpost insulator-3 4, 17.5kv, 1000A bushing –2 (HV 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, Turret and bushing: HV line 3& neutral bushing1each, 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 & Winding	:	132000 Kg
Oil	:	48700 Kg
Total weight	:	248000 Kg
Shipping weight	:	156000 Kg
Total Oil Quantity	:	56000 Ltrs

QUANTITY : 1 No.

B) 31.5 MVA STATION TRANSFORMER

Description: Station Transformer shall be of 31.5 MVA, 220/ 7.1 KV, 3 Phase, YNd1 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 valve2, Cooler control cabinet-1, inlet & outlet valves (1each) etc.

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

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

Turret and bushing: HV turret 3, LV turret 1, HV line –3 & Neutral bushing1, LV bushing (3) 6, On load tap changer drive –1set

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) 45000

QUANTITY : 1 No.

C) 16 MVA UAT TRANSFORMER (5A & 5B)

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-1, Drain valve2, Cooler control cabinet-1, inlet &out let 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 –1set (as per drg 24560050 328)

Approximate Dimensions : (mm)

a. Overall Dimensions 6200x5400x4900

b. Shipping Dimensions 5400x2700x2800

Weight of Transformer Components: (Kg)

a. Core & Winding 16000

b. Tank, Fittings, radiators 14000

c. Oil 10200

d. Untanking weight 16000

e. Total weight 40000

f. Shipping weight (gas filled) 24000

g. Total Oil Quantity (Litres) 11000

QUANTITY :2 No.

D) 2500 KVA UNIT SERVICE TRANSFORMER

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.

Approximate dimensions: Overall dimensions: 3000 x 2065 x 2900 mm

Weight of Transformer Components.

Core Coil Assembly 7500 Kg

Enclosure 800 Kg

Total Shipping 8300 Kg

QUANTITY- 2 Nos.

E) 2000 KVA STATION SERVICE TRANSFORMER

Description: 2000 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.

Approximate dimensions

Overall dimensions: 2800 x 2065 x 2750 mm

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

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, and accessories etc.

Approximate dimensions: Overall dimensions: 2800 x 2065 x 2750 mm

Weight of Transformer Components

Core Coil Assembly	5800 Kg
Enclosure	800 Kg
Total Shipping weight	6600 Kg

QUANTITY- 8 Nos.

G) 1000 KVA STATION SERVICE TRANSFORMER (UST5A(T), 5B(T), DMCWT 3A, 3B)

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.

Approximate dimensions

Overall dimensions: 2200 x 1665 x 2500 mm

Weight of Transformer Components

Core Coil Assembly 3650 Kg

Enclosure 600 Kg

Total Shipping weight 4250 Kg

QUANTITY- 4 Nos.

H) VFD TRANSFORMER

1600 KVA, 6.6/ 1.25 KV, 3 phase, 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 - 4 Nos.

I) COMMISSIONING OF HIGH VOLTAGE RECTIFIER 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

QUANTITY- 32 Nos.

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

QUANTITY- 16 Nos.

6.3.1.2 Scope of work of Transformer

1. Receipt of transformer and associated loose supplied accessories & Spares including oil in drums from site store/yard, inspection, transporting the above to respective erection location upto plinth, storage, maintenance of N2 gas pressure in transformer tank, erection of transformer and 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.

   Note: Refer Section VII for general technical requirements for erection, testing and commissioning

2. Generator, Station and UAT Transformers that are to be mounted adjacent to PH building shall be transported and placed in the unloading bay of the power house in suitable wagon/trailer. The contractor shall load the transformer from storage yard, transport and unload the transformers on rails, turn the wheels/rollers if necessary, roll the transformers to their respective locations and position 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 in to 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 the transformers.

8. Auxiliary/ Service transformers shall be bolted to the adopter panel/bus duct on both the sides and the busbars shall be connected together. The contractor at no extra cost shall carry out any modification 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 shall be 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.

    The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams. Testing shall be done under the supervision of BHEL/customer Engineers.

11. 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.

12. 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.

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

14. The scope of erection work shall also include minor civil work such as chipping and grouting of the support structure as well as for the support of the transformer, including supply of grouting material.

15. **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.

16. 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 filter machine as well as safety of the transformer.

17. 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.
18. 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.
19. Preservative gas like N_2 shall be supplied by BHEL free of cost to maintain the N_2 pressure during preservation.
20. The contractor shall maintain the equipment erected and commissioned by him until taken over by CUSTOMER or up to the contract period.
21. **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.**
22. **The contractor shall arrange minimum one No. 6000 litre/hour and one No 1000 liter/hour (for ESP transformer) filtering machines.**
23. 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.
24. 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/ 3.3KV HT SWITCHGEAR AND GENERATOR AND TRANFORMER 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 3.5Mtr level in PH building, VFD electrical rooms.

6.6 KV HT Switchgear shall be installed at HT Electrical room at 5Mtr 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 systems up 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, bus bar chamber and CT chamber. Instrument 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 charged after every closing operation making it ready for next enclosure. Springs can also be charged manually in case of failure of auxiliary power to 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 available in BOM.

6.3.2.3 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 site. The material for this shall be supplied by BHEL. Base channels shall be grouted on the opening of the floor. If grouting bolts are required for the panel, the same shall be supplied within the quoted rate. All minor concrete chipping and finishing works are deemed to be included in the scope of the job including. If base frame is to be fabricated, separate rate shall be paid on Tonnage basis.

3. For the panels to be mounted on the trenches, channel supports shall be provided across the cable trenches over which the base frames of the panels shall be mounted. The contractor shall carry out fabrication and erection of Support structures 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 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 at 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 based on the availability 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 vendors' 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 Customer or up to completion of contract period.

19. Any items like lamps, lens, fuse/relays/instruments missed form the custody of 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 as part of panel erection.
24. Scope of work shall also cover drilling of bottom gland plates for cable entry as required.
25. Scope of work shall also covers transportation of earthing trucks and trolleys that are supplied along with switchgear to switchgear room and arrange for handing over to Customer after commissioning of the systems.

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

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

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

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 Resistance box of DC drives, if applicable, shall be part of DC starter panel erection.

4. Scope of work shall also covers transportation of earthing trucks and trolleys that are supplied along with switchgear to switchgear room and arrange for handing over to Customer after commissioning of the systems

6.3.4 BUSDUCTS

6.3.4.1 Scope of Supply

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 Transformer 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. 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 & resistors. 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.
	d) Current	600 Amps for 5 minutes duty cycle.

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 IP52. Protection

Hot Air Blower: 6000 cum/ hour, size 1500 x 1200 x 15000 mm, weight 1 ton approx

15 Erection Details of Busducts:

Sl.No.	Description		Qty
1.	**Main IPB**		
	a.	No. of ducts section (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.)	Refer BD drawing
	b	No. of Flexible Conn. Joints incl. Terminations (Approx.)	Refer BD drawing
	c	No. of Rubber Bellows (Approx.)	Refer BD drawing
	d	Total length of **Main IPB** including Neutral duct: 50 m Approx.	50x3=150 m single phase length
	e	Total length of **Tap-Off IPB**: 20m Approx.	20 x 3=60 m 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 type VT 09 Nos.

ii. Lightning Arrestor (KV, KA) 03 Nos.

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

iv. Weight of the cubicle 4500kg

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/IP23 shall house the following:

i. Dry type epoxy cast NG transformer 1 No.

(75 KVA (cont), 21 KV/220 V; 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.

Weight of structure: 14 MT.

6.3.4.3 Segregated Phase HT Busducts

General Description

6.6KV Segregated phase busduct shall be supplied complete with AL alloy enclosure and conductor, AL alloy barrier, 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 of, UAT, Station Transformer, HT Switchboards and associated interconnection /Tie Bus ducts etc.

Total Length of S P Busduct shall be as mentioned in the BOQ.

Size of Busduct: Dimension: as per drawing provided.

Weight of Busduct: as per drg.

There are no CT's in the busduct.

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	**6.6KV**
Insulation level:	35KV
Materials (Enclosure)	Al alloy Gr 31000
Material (Conductor)	Al. Alloy Gr 63401
Enclosure	
Thickness:	3.15 mm
Barrier thickness:	2 mm
Approx. wt. of seal off bushing	15 kg

B) 6.6KV SP Busduct Details

a)1600 Amp – From Unit Auxiliary Transformer-5A to 6.6KV Switch Board 5CA

From Unit Auxiliary Transformer-5 B to 6.6KV Switch Board 5CB

From 6.6KV Switch Board 5CA to 6.6KV Switch Board OCA

From 6.6KV Switch Board 5CB to 6.6KV Switch Board OCB

From 6.6KV Switch Board 5CA to 6.6KV Switch Board 5CC

From 6.6KV Switch Board 5CB to 6.6KV Switch Board 5CD

From 6.6KV Switch Board 5CC to 6.6KV Switch Board 5CD

b) 2500 Amp – From BD Tap off to 6.6KV Switch Board 0CA

From BD Tap off to 6.6KV Switch Board 0CB

From 6.6KV Switch Board 0CB to 6.6KV Station Switch Board OCD

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

Approximate Length 15 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 fabricated at site and shall be erected as per drawings. Total weight of support structure shall be approximately 140 MT.

6.3.4.4 Scope of works for Busducts

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 all the materials, testing and commissioning of total busduct items, painting and handing over.

Dimensions & 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 payment. However, for variations beyond ±20%, payment 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 if necessary.
5. Fixing of wall bushings/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 works. .
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 if 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. 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. Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer scope of painting).

22. 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 cubicles 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 Aluminum filler wire as per 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 aluminum 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 of busducts, all parts 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 certificate 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 be 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 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 of works covers erection of all above panels, integration of total system, commissioning etc.

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.6.3.3

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. required for calibration and testing shall be arranged by the contractor. All the loose supplied items shall be mounted and wired up within the quoted rate.

6.3.6 BATTERY AND BATTERY CHARGER

The batteries are of heavy duty and maintenance free 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 chargers will be housed in separate cubicles and mounted side by side. Tentative details are as detailed in the BOM.

SCOPE OF WORK OF BATTERY AND BATTERY CHARGER

1 Collection of batteries and battery chargers and all the accessories like cable connectors, inter lock connectors, equalizing connectors, rack insulators, fuse box, loop cables etc. from stores and assembling on the racks and fixing all loose supplied items, as per drawings, laying and termination of loop cables.

2 Filling the individual cells with acid/ alkali – if applicable.

3 Arranging suitable resistive load banks or water load for charging and discharging during charging and discharging cycles.

4 Arranging manpower in shift during battery charging and discharging cycles that may be carried out round the clock as per the code of practice, and conducting other routine tests as per IS under the supervision of BHEL Engineer.

5 Modifications or changes, if any, for the loose supplied items or any minor changes in wiring.

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

Note: If the length of loop cables exceeds 15 Mtrs, separate unit rate shall be considered for the excess length as per the equivalent unit rate available in Rate Schedule.

6.3.7 ABOVE GROUND EARTHING & LIGHTNING PROTECTION INSTALLATION

A) Above ground earthing

1 The scope of work shall include 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 Different type of earthing materials shall be supplied by BHEL and the contractor shall lay and connect the earthing materials as per site requirement. The unit rate quoted for earthing on meter basis shall covers supply of fasteners, Saddles, Spacers, lugs for earthing wires, minor civil works, painting on welded joints including supply of anti corrosive primer and paint etc.

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

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

5 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 materials including earth electrodes, cement, brick, sand etc.

6 Earthing System Installation scope covers, earthing of all cable trays 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 splices.

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 shall be painted with anti- corrosive paint/ compound after checking and testing.

10 Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

11 Supply of anti corrosive primer and paint is in contractor's scope.

12 Generator neutral from the NGT/NGR cubicle shall be earthed using two dedicated rod electrodes, which shall in turn be connected to the main plant grid.

13 Generator transformer neutral shall be earthed using 2 dedicated rod electrodes.

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

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

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

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

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 work for Lightning Protection system includes installation of vertical air terminations, Horizontal conductors, vertical risers, down conductors, fabrication of fixing clamps, test links, earth electrodes, supply of saddles, clamps, and associated minor civil works etc.

2 HORIZONTAL/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 shall include supply of TEST LINK.** Test links shall be supplied and 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 lightning earth electrodes and Test link down conductor, refilling of the excavated earth, consolidation etc. 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 and supply of grouting materials are in the scope of Contractor. The supply of above base plate is in the scope of Contractor.

8 **The unit rate quoted on sets (Nos) basis for vertical air terminations includes supply of VERTICAL TERMINAL, base plates, chipping and minor civil works, grouting and supply of grouting materials.** Both vertical and horizontal conductors shall connect the air terminal.

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.

6.3.8 SCOPE OF WORK OF CABLES :

BHEL will supply HT and LT cables (11kv/ 6.6kv/ 3.3 kv/ 1.1 KV, Armoured/ Unarmoured, Aluminium /Copper PVC FRLS/ XLPE 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 applicable.

4. The scope of work for HT cables shall include laying & termination, drilling of holes in the panels, gland plates, fixing of glands, ferrules, tag plates with necessary numbering, including fixing of **Trefoil clamps and clamping** as per BHEL specification.

5. Separate rate shall be paid for termination of HT cables as well as LT Power cables of core size 10 sq. mm and above. For all other cables, a composite rate shall be quoted for laying and termination.

6. If cables have to be routed on steel angles as per site condition, steel angles will be supplied by BHEL. Any fabrication required at site for cable support shall be carried out at extra cost.

7. **All the dressing material such as Aluminum/GI strips, PVC ties etc. required for cable shall be arranged by the contractor within the rate quoted.**

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

    a. Modification such as rotating the terminal box through 90° or 180° as required.

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

10. **The approximate number of termination for the purpose of estimation 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.**

11. **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

12. No separate rate shall be applicable for termination of LT control cables. For LT control cable joining, if any, separate rate shall be considered as per clauses referred elsewhere.

13. 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.

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

15. Termination of all the cables laid by the contractor is included in his scope. The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary.

16. In case the cable is to be terminated on equipment/ panel erected by another agency, then the contractor shall coordinate for removal and drilling gland plates, fixing cable glands etc.

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

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

19. 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

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

6.3.9 CABLE TRAYS / CONDUITS/ FLEXIBLE CONDUITS

Scope of cable tray works covers erection various sizes of ladder & perforated trays with accessories in Power House building & ESP area that includes cable 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. Scope of cable tray works covers erection of various sizes of trays with accessories such elbow, cross, TEEs, bends (90° vertical and Horizontal), reducers, coupler plates/fixing plates, anchor bolts, fasteners etc.
2. If accessories such as TEEs, reducers, bends (90° vertical and Horizontal), cross etc. are not supplied, the same shall be fabricated wherever required from straight trays. The accessories supplied maybe modified to suit site routing as part of work.
3. The scope also covers making offsets by cutting standard tray sections and inserting suitable size of trays to match with the existing arrangement.
4. The unit rate for erection of trays shall be on meter basis which includes erection of trays and accessories, fabrication of tray accessories and modification of straight trays, if required.
5. No separate rate shall be paid for any fabrication of tray accessories or any modification on straight trays.
6. If tray covers are supplied, the same shall 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.
7. Welded Joints of trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS 3043. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.
8. Cable tray mounting structure shall be welded to the plate inserts or to steel structural beams/ members. Welding of cable tray mounting structure to steel structural beams/ members shall be done with prior approval of Customer/ BHEL Engineer.

B- RIGID & FLEXIBLE CONDUITS

1. Cables shall normally be laid on cable trays. However, in case of shorter routes 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. The supply of suitable clamps, fasteners and tag plates are in contractor's scope.

3. In the case 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.

6.3.10 SCOPE OF WORK OF JUNCTION BOXES/MARSHALLING & PUSH BUTTON BOXES:

Different type of Electrical Junction boxes/ Push button boxes shall be supplied. The scope of installation of Junction boxes/ Push 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. Payment for Fabrication and fixing of supports shall be on tonnage basis.
3. The contractor shall close all unused holes on the gland plates using grommet or other suitable material issued by BHEL.
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.**

6.3.11 SCOPE OF FABRICATION & INSTALLATION OF STEEL MATERIALS

1. Scope of steel fabrication and installation covers, fabrication and installation of various types of supports for cable tray, GI pipes, Impulse pipes, JB, Control Box/Panel, local push Buttons, busducts etc, Racks for Instruments with angles and channels, plates etc. of different sizes.
2. Above fabrication steel materials shall be supplied in standard lengths by BHEL.
3. Fabrication shall be carried out as per schemes in consultation with site engineers.
4. All site fabricated items shall be painted with two coats of red oxide primer and two coats of epoxy based paint. The paint shade shall be approved by BHEL Site in charge. 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 or supports if any minor grouting is required the same shall be carried out by the contractor. 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 is in the scope of contractor.
7. A composite single rate shall be quoted for fabrication and installation of steel, on tonnage basis. The above rate shall include supply of paints and painting, grouting and grouting material as required.

6.3.12 SCOPE OF PAINTING:

1 The scope of painting generally covers all steel items such as cable supports, racks, frames, canopy, Tray modification etc fabricated and erected by the contractor, besides touch up paints wherever required.

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

3 Touch up painting is generally required for trays, control panels, junction boxes, welding joints of earthing materials etc. Full painting shall be required for specific equipments as per the scope of erection.

4 All damaged painted surfaces shall be cleaned and painted as detailed above.

5 All wedding joints and damaged galvanized surfaces cable trays and other GI Materials shall be coated with cold galvanizing paint.

6 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.

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 as mounted on equipment or as loose.
2. Contractor shall maintain 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 no extra cost.**

7. **The contractor shall carry out calibration with their own calibration and testing equipments and testing teams. Calibration and Testing shall be done under the supervision of BHEL/CUSTOMER Engineers.**

6.3.14 SCOPE OF CIVIL WORKS

Only minor civil works like drilling, chipping and punching & opening in concrete floors, slabs/ brick walls, grouting of busduct/ Transformer supports in foundation, base frame of panels/ push button stations/ Junction Boxes etc. , including supply of grouting materials like cement, sand, etc., and cleaning of all debris are covered in the scope of this contract.

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

No separate payment will be applicable for above civil works.

6.3.15 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR

1 All types of HT Drives and Generator

a- Cable identification, checking and meggering.

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

c- Dry out 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

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

2 ESP Transformer

a- Dry out of transformers (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 types of drives and motor operated valves**

a) Cable identification, checking and meggering.

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

c) Dry out 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 motors and testing and commissioning from local as well as remote.

g) Attending to any defects till the handing over of the unit to customer by 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 field 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 Sl No1, 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

c) 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 plants is referred below:

    i) Trial run of various equipment.

    ii) Light up of boiler.

    iii) Boiler acid cleaning.

    iv) Boiler alkali boil out.

    v) Turbine barring gear.

    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 work.

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 covered elsewhere.

8. Minimum requirement of Man Power for testing/checking works shall be as follows:

		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 possess 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 assistance to be provided by the contractor shall cover the equipment/drives erected by the mechanical contractors as detailed in the BOQ.**

6.3.17 LUMPSUM UNIT RATE

Unit rate to be quoted on lump sum basis shall include installation of all loose items which are not explicitly mentioned, but comes as part of the system, integration of total system and commissioning. No separate rate shall be payable for loose items. The quantities of loose supplied items are approximate only. No proportional rate will be applicable for any variation in quantity or for any additional items supplied as part of equipments.

6.4.0 COLLECTION OF BHEL SCOPE OF SUPPLY MATERIALS

6.4.1 BHEL shall issue materials covered in BHEL scope from their stores at site. The contractor shall collect such materials from BHEL stores and transport to his worksite at the contractor's cost.

6.4.2 The contractor shall inspect such materials as soon as received by the contractor and shall bring to the attention of the Engineer-in-Charge any shortage / damage or other defects noticed before taking over the materials. Materials once taken over will be deemed to have been received in good condition and in correct quantities except for intrinsic defects which cannot be observed by visual and dimensional inspection and weighing.

6.4.3 Upon receipt by the contractor the responsibility for any loss, damage and / or misuse of such materials shall rest with the contractor.

6.4.4 All materials issued by BHEL shall be properly stored and systematic records of receipts, issue and disposal will be maintained. Periodic inventory shall be made available to BHEL Engineer-in-Charge.

6.4.5 All materials issued by BHEL shall be utilized as directed by Engineer-in-Charge or most economically in the absence of such direction. The contractor shall be responsible for the return to BHEL Stores of all surplus material, as determined by the Engineer-in-Charge.

6.4.6 If the materials issued by BHEL are lost, damaged or unaccounted, the cost of such items shall be recovered from payments to the contractor. However, the contractor shall raise FIR and inform BHEL all details.

6.5.0 STORAGE:

6.5.1 The equipment should be preferably in its original package and should not be unpacked until it absolutely necessary for its installation. The equipment should be best protected in its cases. It should be arranged away from walls.

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 replaced when decolorisation takes place or regenerated.

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

6.5.5 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 be 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 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 categorised and stored separately.

6.6.0 T&P TO BE PROVIDED BY BHEL FREE OF CHARGE

BHEL shall provide the following T&P free of hire charges on sharing basis.

1. 75/18 Tons crane --- 1 No
2. EOT crane.

However, the contractor shall arrange fuel and operator.

6.7.0 TOOLS AND PLANT TO BE ARRANGED BY THE CONTRACTOR

6.7.1 Equipment, vehicles, tools and plants and materials 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.

6.7.2 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.

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

6.7.4 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.

6.7.5 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 any part of the work liable to damage by exposure to the weather and shall take every reasonable precaution against accident or damage to the work from any cause.

6.8.0 MATERIALS/CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR FOR ERECTION AND COMMISSIONING AS PART OF THE SCOPE WITHIN THE QUOTED RATE

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 TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

1 CABLE LUGS:

a)	Type:	Solderless crimping type
b)	Material	Copper / Aluminium
c)	Whether tinning required (For copper cable lugs)	Yes.
d)	Thickness of tinning:	10 microns
e)	Applicable Standard for LT Cables	IS:8309
f)	Approved Vendors	Dowels/ Lotus/ Jainson/ Power Engineering/ KlipOn/ Multi (Any other make proposed by bidder shall be subject to BHEL's approval)

2 FERRULES:

a)	Colour of ferrules:	Yellow/White
b)	Colour of engraving	Black

3. TAGS:

a)	Material :	Al/Fiberglass/ Stainless Steel
b)	Markings:	Engraving/Embossing/Printing

6.10.0 MANPOWER REQUIREMENT FOR ERECTION.

Manpower requirement for Erection and Commissioning shall as follows:

6.10.1 There shall be a Resident manager as Site In Charge at site, under whom there shall be 3 erection engineers who shall be in charge of TRANSFORMER&BUSDUCT, SWITCHGEAR&CONTROL PANELS AND CABLES.

6.10.2 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.

6.10.3 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.

6.10.4 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

6.10.5 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 arises, the presence of the contractor's site Representative at site can be called for.

6.10.6 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.

6.10.7 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.

6.10.8 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 by the Engineer-in-Charge.

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

6.11.0 DOCUMENTATION

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

a) Bar chart covering planned activities at site

b) Detailed organization chart

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

Test certificates of various tests conducted at site.

6.11.3 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/documents shall be submitted by the contractor as agreed for the project.

6.12.0 PROGRESS AND MONITORING OF WORK

6.12.1 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.

6.12.2 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, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

6.12.3 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 contract each month.

6.12.4 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 completion date.

6.12.5 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.

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

6.12.7 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 or system as required by BHEL.

6.13.0 ELECTRICAL INSPECTORATE'S APPROVAL:

a. All electrical installation 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, REGISTRATION FEES, ETC). However any expenditure related to documentation shall be borne by contractor.

6.14.0 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 along 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 plan 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.

6.15.0 MEASUREMENTS & WASTAGE & CUTTING ALLOWANCES:

6.15.1 For all payment purposes, measurement shall be made on the basis of the execution of drawings/physical measurements. Physical measurements shall be made by the contractor in the presence of the Engineer.

6.15.2 The measurement for cable, impulse pipes/tubes, GI pipe, conduits, flexible conduits, trays etc. shall be made on the basis of length actually laid.

6.15.3 All the surplus, scrap and serviceable materials, out of the quantity issued to the contractor shall be returned to BHEL in good condition and as directed by the engineer.

6.15.4 All materials returned to stores should carry an aluminium tag indicating the size and type. More than 5 metres length termed as serviceable material and shall be returned size wise and category wise to the owner's stores/yard. Cable of serviceable length being returned to the stores in drums shall have their free ends sealed and the balance lengths on the drum(s) shall be noted and certified by the Engineer-in-charge. This shall be applicable only for the purpose of accounting the cables issued for installation.

6.15.5 While carrying out material reconciliation with contractor, all the above points will be taken into account. All serviceable material returned by the contractor shall be deducted from the quantities issued for the respective sizes and categories and the balance quantity(ies) will be taken as the net quantity(ies) issued to the contractor. Material appropriation shall be done and allowable scrap quantity calculated as per wastage allowance specified in Section VII. Any scrap/wastage generated by the contractor in excess of the allowable percentage shall be charged at the rates decided by the Engineer whose decision shall be final and binding on the contractor.

6.15.6 For all site-fabricated steel items such as supports, racks, frames, Canopy etc. physical measurement shall be made and then converted to tonnage. For steel material supplied to the contractor, all scrap shall be returned to BHEL stores with due accounting.

6.15.7 Every month the contractor shall submit an account for all the materials issued to him by BHEL in the standard pro forma prescribed for this purpose by the site in charge.

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

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

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

6.15.10 The cable take off from drums shall be planned strategically such that jointing in the run of cables and wastage are avoided. for this purpose the exact route length between various equipment/panels as per the cable schedule shall be measured and the route length recorded before laying of the cables Depending upon the route length the type of cable required for various destinations, the cable drums shall be suitably selected for cable laying. Any jointing which may be approved by the engineer all the cut pieces/bits of cables which are not used/unused shall be returned to the purchaser for accounting towards wastage. The cables damaged by the contractor shall have to be replaced by the contractor at his own cost.

6.16.0 TERMS OF PAYMENT

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

93% payment will be made on prorata basis on Erection and commissioning as detailed below.; 2 % on submission and acceptance of final bills and the final 5% will be paid after the guarantee period.

6.16.1 For transformers:

a.	Receipt, transport to the placement of erection on Placement, assembly, alignment, grouting mounting and wiring loose parts 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 painting	3 %

6.16.2 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	23%

6.16.3 Laying and termination of HT cable

a.	Laying /tagging /termination on pro rata basis and protocol signed	70%
b.	Checking, Fixing Trefoil calmps and Highpot test on pro rata basis and protocol signed	20%
c.	On submission of as built drawing	3%

6.16.4 For VFD systems

a.	Receipt, transport to erection site, Placement, assembly fixing and clamping, Adjustment, Alignment and electrical interconnections	70%
b.	Pre-commissioning tests, checks, calibration and making ready for energisation on pro rata basis	23%

6.16.5 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	3%

6.16.6 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 as build drawing	3 %

6.16.7 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 painting	3%

6.16.8 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	23%

6.16.9 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) 18% of the accepted rate on commissioning of the system.

6.16.10 For all categories of above works, the guarantee period shall be for 6 months from the date of handing over of work to Customer or 12 months from the date of first synchronisation, whichever is earlier.

However, the above guarantee amount shall be released against submission of bank guarantee for an equivalent amount from a nationalized/scheduled bank in the prescribed pro forma of BHEL.

6.17.0 TIME SCHEDULE

6.17.1 The entire scope of work erection, testing and commissioning shall be completed within **11 months** as detailed in overall erection commissioning programs

6.17.2 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 5.

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)	Handing over	11 months from start of work

6.17.3 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 rates.

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

6.17.5 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.

6.17.6 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 month and also any material received during the month. Contractor shall mobilize his resources required to achieve the monthly programmes.

6.17.7 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.

6.17.8 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.

6.18.0 OVER RUN CHARGES

In case due to reasons not attributable to the contractor, the work gets delayed and completion time gets extended **beyond 11 months**, the contractor may be considered for over run compensation. If eligible and considered , Contractor shall be entitled to claim ORC after 11 months from the commencement of work at site. And the contractor shall be paid Over Run compensation of **Rs.75,000/-** (Rupees Seventy five Thousand only) per month for the extended period beyond **11 months**.

6.18.1 . Contractor is not entitled to avail ORC for the work for which sufficient work front and time was available during the contract period and if the contractor could not attend due to his own reasons during the contract period and try to complete after the contract period, ORC payments shall be paid only after approval of competent authority

6.18.2 The payment of over run 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.

6.18.3 The period of over run compensation will have to be ascertained before commencement of the ORC period.

6.18.4 Contractor is not entitled to avail ORC for the work for which sufficient work front and time was available during the contract period and if the contractor could not attend due to his own reasons during the contract period and try to complete after the contract period, ORC payments shall be paid only after approval of competent authority.

6.19.0 EXTRA CHARGES FOR MODIFICATION AND RECTIFICATION WORK

6.19.1 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.

6.19.2 The decision of BHEL in this regard shall be final and binding on the contractor. 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 those work done through other agencies if they so desire.

6.19.3 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 designers/supplier or competent authority only shall be considered for payment.

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

6.19.5 The following man hour rates shall be applicable for modification/rectification work.

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

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

Extra works are broadly defined as below:

- Design changes which shall be intimated to the contractor after the start of the work which calls for dismantling of the erected components, rectification, modification, etc.

- Modification, rectification of erection wrongly erected /fabricated at site as per drawing subject to acceptance by approving authority.
- Jobs which require major modification, major repair, major reworks etc which shall be identified as major and warrant extra, payment, certified as such by the Project Manager and accepted by the designers/competent authority of BHEL.

6.19.6 However prior to carryout the repair/rework BHEL site will obtain administrative approval with the estimate before starting the works.

6.19.7 The decision of BHEL in this regarding the Extra works shall be final and binding on the contractor.

6.20.0 REPORTING DAMAGES AND CARRYING OUT REPAIRS

6.20.1 Checking all components/equipments at siding/site 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 non-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 INSPECTION OF WORKS

6.21.1 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.

6.22.0 GUARANTEE PERIOD

6.22.1 All the works executed by the contractor including supplies are to be guaranteed for a period of 12 months from the start of guarantee period. The contractor shall be responsible for the quality of workmanship and shall guarantee the work done, shall rectify/replace at no extra cost all defects due to faulty supply/erection and commissioning during the guarantee period.

6.22.2 The guarantee period shall start 6 months from the date of first synchronisation or from the date of handing over to customer , which ever is earlier.

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

6.23.0 PRICE VARIATION

The price variation clause applicable will be as indicated below :

The finally accepted rates for scope of work as defined in this tender are subjected to price escalation provisions as per the following formulae.

P1 = 0.75 x P0 (F1-F0)/F0

P1 = Increase in billing amount (escalation for the particular month of billing)

P0 = Billing amount calculated on the accepted contract rate

F1 = New All India Average CPI published by Labour Bureau, Simla, Government of India for Industrial workers (Base 2001 - 100) applicable for the month under consideration i.e. for which bill has been raised.

F0 = New All India Average CPI published by Labour Bureau, Simla, Government of India for Industrial workers (Base 2001-100) applicable with base index for the schedule date of bid submission.

Price escalation as per above formula shall be calculated and paid (excluding payments towards extra works and overrun, if any), on month to month basis.. BHEL however reserves the right to freeze escalation for that such of duration of delays, from time to time, which are entirely attributable to the contractor.

With the provision of prior escalation as per above clause, no claim/compensation on account of any increase whatsoever, (irrespective of whether escalation are steep/ unanticipated or not compensated by the above escalation provisions in full towards minimum wages, consumables, electrodes, gases or any other items/reason) shall be payable during the entire period of execution including extended period, if any.

6.24.0 **Taxes and Duties**

6.24.1 Value Added Tax (VAT) for the works

Price quoted shall be inclusive of VAT except service tax.

Notwithstanding the fact that this is only an erection service contract not involving any transfer of materials whatsoever and not attracting VAT liability, being labour oriented job work, for the purpose of VAT 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 VAT Registration No. and VAT paid for the purchases,etc

The bidder shall get registered with State VAT authorities and the registration certificate shall be forwarded to BHEL immediately after commencement of work. In case the bidder had already registered under respective State VAT, they must quote their registration Number and forward copy of Registration Certificate while submitting this tender. The bidder has to obtain VAT clearance certificate from the concerned authorities, on completion of work and submit along with the final bill as one of the documents for contract closure.

In case the Bidder decides to include any VAT element along with the quoted price, they shall specify (1) The value of VAT included in the quote, (2) the rate of VAT adopted and (3) On what value etc , as additional information, in the price bid.. If no VAT element is included in the price, the same shall be indicated in the quote.

The bidder shall quote very competitive price after taking into consideration of above points.

6.24.2 Service Tax

Price quoted shall be exclusive of Service Tax. The service tax as statutorily leviable and payable by the bidder under the provisions of service tax Law / Act shall be paid by BHEL as per bidder claim through various running bills. The bidder shall furnish proof of service tax registration with Central Excise Department specifying the name of services covered under this contract. Registration Certificate should also bear the endorsement for the premises from where the billing shall be done by the bidder on BHEL for this project. The bidder shall obtain prior consent of BHEL before billing the service tax amount.

6.24.3 Other Taxes & Levies

Any other taxes and duties (except VAT & Service Tax) viz. Entry Tax, Octroi, Seigniorage, Licenses, Deposits, Royalty, Stamp Duty, other charges / levies, etc. prevailing / applicable on the date of opening of technical bids and any variation thereof during the tenure of the contract **are in the scope of bidder**. In case BHEL is forced to pay any such taxes, BHEL shall have the right to recover the same from the bidder either from running bills or otherwise as deemed fit.

6.24.4 New Levies / Taxes

In case Government imposes any new levy / tax after award of the work during the tenure of the contract, BHEL shall reimburse the same at actuals on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract.

6.24.5 Statutory variations

Statutory variations are applicable only in the cases of Value Added Tax and Service Tax. The changes implemented by the Central / State Government in the VAT Act / Service Tax during the tenure of the contract viz. increase /decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitablypaid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favour of BHEL. No other variations shall be allowed during the tenure of the contract including extended period, if any.

6.24.6 Direct Tax

BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

6.25.0 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.

6.26.0 PROVIDENT FUND & MINIMUM WAGES

6.26.1 The contractor is required to extend the benefit of Provident Fund to the labour employed in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, Contractor is required to get himself registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted by the Provident Fund authorities within one month from the date of issue of this letter of intent. Incase the contractor is e exempted from such remittance, an attested copy of authority for such exemption is to be furnished. Please note that in the event of failure to comply with the provisions of said Act, if recoveries there for 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 the contractor.

6.26.2 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.
The final bill amount would be released only on production of clearance certificate from PF/ESI and labour authorities as applicable.

6.27.0 IMPORTANT CONDITIONS FOR PAYMENT

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

1. PF Regn. No.
2. Labour Licence No.
3. Workmen Insurance Policy No.
4. Un Qualified Acceptance for Detailed L.O.I.
5. Initial 50% Security Deposit.
6. Rs. 100/- Stamp Paper for Preparation of contract agreement

All payments due to the contractor shall be made only through "e-Payment" , including return of EMD amount to unsuccessful tenderers. The tenderer has to furnish details of his Bank account as certified by the concerned Banker in the format furnished to enable e-payment.

FORM TO BE FILLED BY VENDORS FOR REGISTERING FOR E-PAYMENT

Details of Bank Account details of Contractor for remittance of e-Payment

1	NAME & ADDRESS OF THE CONTRACTOR / SUPPLIER	:
2	BANK A/C NO.	:
3	TYPE OF A/C (CC / CURRENT)	:
4	NAME OF THE BANK	:
5	NAME OF THE BRANCH	:
6	BRANCH CODE	:
7	BANKER'S ADDRESS (BRANCH)	:
8	MICR NO.	:
9	IFSC CODE	

Note : THE ABOVE DETAILS ARE TO BE FURNISHED IN THEIR LETTER HEAD BY THE CONTRACTOR / SUPPLIER, DULY ATTESTED BY THEIR BANKERS.

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ANNEXURE-VI A

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

S.NO	CATEGORY	MONTHS 1 2 3 4 5 6 7 8 AND SO ON .....
01	Resident Manager	
02	Engineers	
03	Supervisors	
	a. Mechanical	
	b. Electrical	
	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 Stations.

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

ANNEXURE - VI B

DEPLOYMENT PLAN FOR MAJOR TOOLS AND PLANTS / INSTRUMENTS

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

S.NO	CATEGORY	MONTHS 1 2 3 4 5 6 & SO ON	PRESENT LOCATION
01	Welding Generators		
02	Welding Transformer		
03	TIG Welding sets (air cooled)		
04	Insulation Tester a. Motorised Megger 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 LPHfor 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
		1 2 3 4 5 6 & SO ON	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.

ANNEXURE-VI C

RECOMMENDED LIST OF TOOLS AND TACKLES / INSTRUMENTS FOR ELECT WORKS TO BE ARRANGED BY CONTRACTOR AT HIS COST

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 ohms

ii) Hand operated megger - 0.5 KV/1.0 KV/2.5 KV, 200 - 100 M ohm

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 - 250 V 0-5-10A.

h) Multimeter - analogue :acV 2.5V - 2500V, ac A - 100 mA - 10 A
dc V 25.V - 2500V, dc A - 50mA - 10A
Resistance - 0 - 200 M ohms
digital : voltages ac & dc - 100mv - 1000 V
current 10-mA - 10A Resistance - 0-20 M ohms

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

j) Variac - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A.

k) Primary injection kit - 0-5000 A.

l) Secondary injection kit - 0-5A.

m) HV Test kit - 50 KV AC 400kVA.

n) Wheat stone bridge - 0.05 m 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 65Hz.

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

u) Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.

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

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 2500V AC	± 1.0%
		Current 100 mA to 10A AC	± 2.0%
		Current 250 micro A to 1A DC	± 1.5%
		Resistance upto 100 ohms	± 3.0%
		Voltage 2.5V to 2500V DC	± 1%
3	Digital Multimeter	Voltage 200mV to 1000 V DC	± 1% + 1 digit
		Philips Voltage 200mV to 1000 V AC	± 1% + 1 digit
		Hcl Current 200mA to 20 A AC	± 0.8% + 1 digit

Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
		Philips Current 20 mA to 20 A AC	± 0.8% + 1 digit
		Resistance (Hcl) 2120 200* to 200M*	± 0.5% + 1 digit
		Resistance (Hcl) 2105 200* to 200M*	± 0.25% + 1 digit
		Hcl Voltage 200mA to 750 V	± 0.8% + 1 digit
		Philips Current 20 mA to 20 A DC	± 0.5% + 1 digit
		Hcl Current 200 mA to 010 A AC	± 1% + 1 digit
4	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	± 0.5% mm/sec
		Displacement upto 300 microns	± 2 microns
5	Secondary Injection Kit	Upto 5A	± 0.5mA
6	Motor operated Megger	Upto 200 Ohms	± 5% at Centre scale
7	Tongue tester	0/300/600A AC	± 5%
		0 to 300A DC	± 5%
8	Tachometer (Hand held	0 to 4000 rpm	± 5%
9	Phase Sequence Meter		N/A
10	Three Phase Variac	15 A Capacity	N/A
11	Feeler gauges	300 mm long and 100 mm long	± 2 microns
12	Dial gauges	Q	± 0.01 mm
13	Hand operated Megger 500 V / 1000V	Upto 200 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
14	Motorised Megger 2.5 KV	Upto 200 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
15	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	± 5% at Centre Scale range
16	AC tongue Tester	0 to 300A AC	± 3%
17	DC Tongue Tester	0 to 300A DC	± 5%
18	High Voltage test Kit	Upto 50 KV AC	± 10%
		Upto 70 KV DC	± 10%

Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
19	Tacho Generator (Mech)	0 to 4000 rpm	± 0.25%
20	DC Ammeter	0 to 300 A	± 10%
21	DC Voltmeter	0 to 500 V	± 10%

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. BHEL will provide crane of capacity 18 T or above for Busduct / Transformer / HT switch gear erection works as free issue on sharing basis. The The contractor at his cost shall arrange all cranes and truck/tractor, trailers required for material handling purpose and also cranes required for erection. If contractor requires any equipments other than what is mentioned as free issues 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 shallhave 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 to 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.

k. The contractor shall arrange 6000 LPH oil filtering M/c and 1000 LPH (for ESP transformers) for transformer oil filtration.

BHEL PS:SR **Format No. CP: FEX**

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. CAL. AGENCY NEXT DUE DATE DATE OF CAL. CAL. AGENCY NEXT DUE DATE

SIGN OF SITE CIC

SECTION VII

RAYALASEEMA TPS UNIT 5 (1 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 contractor 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 form 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 despatched 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 busducts 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.

7.2.3A Caution

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 damages.

7.2.4 HANDLING OF BUS DUCT.

Handling from delivery 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 material in original packings unless required for erection.

5. Ensure 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 items and flexibles are stored in well ventilated area.

DON'Ts

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 keep door of cubicle open during storage.

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 the 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 are 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 completed.

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 of various items. All the drawings necessary for assembly and erection are furnished separately.

Busducts are usually despatched as single phase assemblies generally assembled with busbars. The busbars are braced with steel clamps to avoid any damage to insulators and displacement of busbars during transport. Structures, hardwares, flexibles, and other miscellaneous items are packed 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 centre 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 in advance, which may consist of levelling 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, levelled 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 levels 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 of enclosure 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, levelling 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 assemblies 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) alongwith 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 Side

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 match 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 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 Aluminium surface (Unplated)

Follow Instructions given under 7.2.11A 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 surfaces (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 that 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 particles or other abrasives 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 NM to 1.7 NM (30-40 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-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 nut till belleville washer becomes flat. Then unscrew the nut by about 1/8 th. turn.

7.2.13 RECOMMENDATION 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° to 15° Forehand
Cleaning	:	Decrease and scratch brush
Setting	:	250A to 320A, 28 to 30 Volts (Dependent on tk)
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	:	1.6 mm dia (NG 21 with 5% silicon)
Angle	:	10° to 15° 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 places.

Welding conditions M.I.G. Process :

Filler wire	:	1.6mm dia (NG 21 with 5% silicon)
Angle	:	10° to 15° Forehand

Cleaning	:	Degrease and scratch brush
Setting	:	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 and not allowed to melt away and enclosure.

7.2.14 WELDED BUS ENCLOSURE JOINTS

Bridge the gap between the bus enclosure by means of make up pieces and clean the area by paint removed which is to be welded. Tack weld the make up pieces before final filled weld all around.

7.2.15 WELDED JOINTS OF SHUNTS

Various locations of shunts to be welded to the enclosures are shown 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 minimise 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 to suit at site and two separate earth strap are to be connected to the station earth thus ensuring double earthing.

In some assemblies (such as 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 in turn enclosures should be earthed.

B. Cubicle earthing :

Each cubicle is provided with two number of earthing terminals. These terminals are generally located on side 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 bushings 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 values 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.)
Upto & Including	KV	
3.6	16.8	
7.2	21.6	
12	28	
24	44	
36	60	

E. Meggar-Checks :

Before the application of high voltage, check the insulation of each bus, conductors by means of 2.5 KV meggar. 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 20 mega 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 full 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 despatched separately should be examined carefully for leaks or any sign of tampering,. All drums are despatched 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 0.17 kg/Cm2 (2.5 psi) 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 not 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 complete 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 drawings. 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 transformer 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 CHECK POINTS BEFORE STARTING AND DURING ERECTION

a. 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 shipping frame for bushings have been removed.

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 on 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.

Smoking on or near the transformer shall not be allowed.

Transformer tank, control cabinet etc, 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 boiler- suit pockets etc. before starting the work through man holes.

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 despatched separately should be cleaned inside and outside before being fitted.

xiii. A Transformer is best protected form damp hazard by circulating warm, dry, 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 be 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 air/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 silica-gel breathers and inlet/outlet valves for oil circulation. Recommended capacity 20KL

(iii) Vacuum gauges 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 90 C.

vii) Transparent vacuum-proof tubes for checking of oil-level during oil filling.

ix) Valves, fitting, gaskets etc.

(x) 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 in cooling system.
6. Oil level in bushings.
7. Release air, 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 tests 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

TAN-DELTA test if quality check list calls for.

Dew point check for N2 Gas at the time of oil filling

INSULATION RESISTANCE TEST

Sl.No	Descriptio	DateTime in Hrs	Megger (not less than 500 V)	IR Value	Temp	Remarks
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 Transformer 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 works 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 craftsmen.

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 ERECTION

Layout of foundation channels.

Floor level covered by the panel with respect to main floor level.

Location and serial no. of panels.

Positioning of panels.

Verticality of switchgear panels within the limit specified.

Freeness of Breaker Truck and modules in housing and its manual operation.

Earthing of panels and breaker truck to station earth.

Lugs for termination of HT and LT cables.

Mounting and fixing arrangements of Bus bars.

Tightening of Busbar jointing bolts as specified.

Clearance between :

Phase to Phase

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 breaker.

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, 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 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 craftsmen

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

Layout of foundation channels.

Floor level covered by the panel with respect to main floor level.

Location and serial no. of panels.

Positioning of panels.

Verticality of switchgear panels within the limit specified.

Freeness of Breaker Truck and modules in housing and its manual operation.

Earthing of panels and breaker truck to station earth.

Lugs for termination of LT cables.

Mounting and fixing arrangements of Bus bars.

Tightening of Busbar jointing bolts as specified.

Clearance between :

Phase to Phase

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.

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 and 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 connections.

7. Check for all alarm conditions.
8. Checking and clibration 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 at 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 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.

3 Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.

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 of 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 through trenches/tunnels/basements etc. to individual drive/control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment in the panels located, above trenches, tunnels or basement.

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 of 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), for cabling system shall be adopted.

12 For 415V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded/exposed GI conduits or rigid PVC pipes as applicable.

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 cables shall run over rollers placed at close intervals and finally transferred carefully on the racks/trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.

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 an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255.

23 All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor/wall crossings, every 25m spacing for straight runs or as specified by Engineer for easy identification of cable.

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 1100 V 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 cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanised MS saddles/aluminium strips/nylon cable ties. Cables above 35mm diameter shall be clamped individually.

28 Control cables shall be laid touching each other and wherever required may be taken in two layers. All control cables shall be clamped with a common clamp/tie.

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) next 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 the special control cables with clear minimum gap of 100 mm between them.

37 LT power cables are mixed up with control cable 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 200 mm 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 galvanised.

42 For laying cables along concrete walls, ceilings etc. The cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 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 material harmful to the cable sheaths shall not be used.

44 No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits/pipes in trefoil formation only.

45 In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.

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 the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.

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 the requirements of IS 1255.

50 SUPPORT SPACINGS & CLAMPINGS

Trefoil Clamps:

i. Horizontal run spacing :		1000 mm (max)
ii. Vertical run spacing	:	1000 mm (max)
iii Axial spacing between adjacent trefoils		Double the diameter of larger cable or 150 mm Whichever is less

Other Clamps

A. Power Cables:

Above 35mm OD

i) Horizontal runs : Individually clamped at 3000 mm Interval (max)

ii) Vertical runs : Individually clamped 3000mm intervals (max).

Upto 35mm OD

i) Horizontal runs : Collectively clamped at 3000 mm intervals (max)

ii) Vertical runs : Collectively clamped at 2000 mm interval (max)

B. Control Cables:

i) Horizontal runs : Collectively clamped at 3000 mm interval (max)

ii) Vertical runs : Collectively clamped at 3000 mm interval (max)

C. Spacing for cables supported along structure/ceiling

Clamping Spacing:

i) In horizontal runs : 750mm (max)

ii) In vertical runs : 750mm (max)

Spacing between cables : 30 mm (min)

Note:

a. Supports shall also be provided at each bend.

b. 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/termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.
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 terminal lugs, the same shall be of tinned copper compression type.
9. Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.
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 : 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

c) Conductor resistance

e) Capacitance between conductors & earth (for cables above 7C.1.3KV 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 fo 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 on 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 the 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 minutes (if applicable).

15. Measurement of shaft voltage.

16 Tan Delta test for generator bushing. (if required).

b) AC Motors

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 interlockings 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 polarisation index of stator winding, R10/R1 by motorised 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 Motors

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 currents and no load currents (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 coats of epoxy paint of shade 631 of IS:5 as detailed in section VI.

7.8.0 CODES AND STANDARDS

7.7.1 All equipment and materials shall be designed, manufactures and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplimented by this specification.

7.7.2 Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies 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.

IS 3043 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 of protection provided by enclosures for low voltage switchgear and control gear.

IS 5216 Guide for safety procedures and practices in electrical works.

IS 800 Code of practice for use of structural steel

In addition to the standards mentioned above, all works shall conform to the requirements of the following rules and regulations.

a) Indian Electricity Act and Rules framed thereunder

b) Fire insurance regulations

c) Regulations laid down by the Chief Electrical Inspector of State 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 specification, the latter shall prevail.

7.10.0 TECHNICAL REQUIREMENT FOR ITEMS SUPPLIED 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 bolts etc., which form part of the equipment or which are necessary for safe and satisfactory installation and operation 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.

Samples of all items shall be made available for purchaser's approval prior to supply of item to site.

2 FERRULES

a) Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter.

b) Ferrules shall be of plastic material.

c) Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave 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 ferrule 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 have 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. **GPG 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 first 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 conduits 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 not be greater than 40%.

7.10.7 The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminium or galvanised 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. **Ferrules** : 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

SECTION VIII

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:1336 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 VIII

APPENDIX – II

TENDER SPECIFICATION NO BHEL:PSSR:SCT:1336

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 Govt. of India Undertaking)
Power Sector – Southern Region
EVR Periyar Building
690 , Anna Salai, Nandanam, Chennai – 600 035.

SECTION VIII

APPENDIX - III

CHECK LIST

TENDER SPECTFICATION NO, BHEL: PSSR : SCT : 1336

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 status	:	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

RAYALASEEMA TPP : STAGE II UNIT 3 & 4 (2 X 210 MW) ELECTRICAL (HT & LT) PACKAGE

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*** **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 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*	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:
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	**Station Switchboard 0CC** 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
A2.6	**Station Switchboard 0CD** 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
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
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.* ***Final painting as per spec and approval of BHEL***	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:
B1.2	***2500 KVA UNIT SERVICE TRANSFORMER (EPT-3A&3B , 4A&4B,)*** **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. **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)*** **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. **Approximate dimensions and Weight of Transformer** Overall dimensions : 2800 x 2065 x 2750 mm 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)*** **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. **Approximate dimensions and Weight of Transformer** 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)*** **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. **Approximate dimensions and Weight of Transformer** Overall dimensions : 2200 x 1665 x 2500 mm 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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
B2	***HT BUSDUCTS***				
B2	**IP BUS DUCT (15.75 KV)**				
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 **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	

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
C	***BHEL- PEM SCOPE***				
C1.0	**NEUTRAL GROUNDING RESISTOR**				
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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**

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
C15.3	***8 SWG GI Wire***	***2725Mtrs***	***2725Mtrs***	***5450Mtrs***	6.3.6.A

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
D3.2	***2 C X 2.5 sq. mm, Cu, Armoured***	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
D3.3	***3 C X 6.0 sq. mm, Cu, Armoured***	1000 Mtrs	1000 Mtrs	2000 Mtrs	6.3.10
D3.4	***Cable termination 3 C X 2.5 sq. mm,***	300 Nos	300nos	600nos	6.3.10.13-21
D3.5	***Cable termination 3 C X 6.0 sq. mm***	24 Nos	24 Nos	48 Nos	6.3.10.13-21
D3.6	***Cable termination 2 C X 2.5 sq. mm***	10 Nos	10 Nos	20 Nos	6.3.10.13-21
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
D.5.0	*CABLE TRAYS*				
D.5.1	***Perforated Type, 100 mm tray***	875 Mtrs	875 Mtrs	1750 Mtrs	
D6.0	*COMMISSIONING* of the following erected by Mechanical Contractor				6.3.15
D6.1	Soot Blower Motors (WB, LRB, AH) Trichy	138 Nos.	138 Nos.	276 Nos.	6.3.15
D6.2	Hoists/cranes/monorail/elevator	1 No	1 No	2 Nos	6.3.15

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
E	***BHEL - RANIPET SCOPE***				
E1.0	**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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
E3.3	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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
E6.5	***4C x 1.5 sq. mm, Cu, Screened cable***	6500 Mtrs	6500 Mtrs	13000 Mtrs	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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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
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
F.4.3	***Earthing Cable, 1 C x 70 sq .mm, PVC, Cu***	***200 Mtrs***	200 Mtrs	400 Mtrs	6.3.10
F.4.4	***Earthing Cable, 1 C x 16 sq .mm, PVC, Cu***	***1000 Mtrs***	***1000 Mtrs***	***2000 Mtrs***	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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
	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
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
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;	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

BOM Ref No:	Description	Qty (Common & Unit 3)	Qty (Unit 4)	Total Qty	Clause Ref No:
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

BOM Ref No	Description	Qty	Unit Rate
H.	**PROVISIONAL RATES TO BE QUOTED FOR FOLLOWING OPTIONAL ITEMS**		
H.0.1	Filtration of Transformer oil	Per kilo litres	
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.		
H.0.3	Aluminium conductor of thickness 8 mm to 15 mm	Per mtr run	
H.0.4	Aluminium enclosure of thickness 6mm to 8mm	Per mtr run	
H.0.5	Aluminium enclosure of thickness below 6 mm	Per mtr run	
H.1.0	**ERECTION**		
H.1.1.	**GI pipe** 150 mm ϕ	(per m)	
HG.1.2.	**CABLES (Laying &Termination)**		
	1.1 kV, Unarmoured Al, PVC/FRLS Power Cable		
H.1.2.1	2 C x 6 sq. mm	(per m)	
H.1.2.2	2 C x 10 sq. mm	(per m)	
H.1.2.3	4 C x 6 sq. mm	(per m)	
H.1.2.4	4 C x 10 sq. mm	(per m)	
	1.1 kV, Unarmoured Cu, PVC/FRLS Power Cable		
H.1.2.5	2 C x 10 sq. mm	(per m)	

H.1.2.6	5 C x 4 sq. mm	(per m)	
H.1.2.7	5 C x 6 sq. mm	(per m)	
	1.1 kV, Unarmoured Cu, PVC/FRLS Control Cable		
H.1.2.8	2 C x 2.5 sq. mm	(per m)	
H.1.2.9	24 C x 2.5 sq. mm	(per m)	
H.1.2.10	2 C x 4 sq. mm	(per m)	
H.1.2.11	5 C x 4 sq. mm	(per m)	
H1.2.12	10 C x 1.5 sq. mm	(per m)	
H.1.2.13	19 C x 1.5 sq. mm	(per m)	
H.1.2.14	27 C x 1.5 sq. mm	(per m)	
H.1.2.15	27 C x 2.5 sq. mm	(per m)	
H.1.3	Excavation of earth in any type of soil and refilling earth	(per cu. m)	
H.2.0	*SUPPLY*		
H.2.1	**Supply** of river bed sand and spreading	(per cu. m)	
H.2.2	**Supply** and Erection of RCC Hume pipes	(per m)	
H.2.3	**Supply** of standard Bricks and spreading	(per cu. m)	
H2.4.0	***SUPPLY of CABLE GLAND for the following armoured (AL) cables***	(per.No)	
H 2.4.1.1	*1 x 4 to 1x 6 Sqmm*	Per No.	
H 2.4.1.2	*1 x 10 to 1 x 16 Sqmm*	Per No.	

H 2.4.1.3	*1 x 25 to 1x35 Sqmm*	Per No.	
H 2.4.1.4	*1 x 50 to 1 x 70 Sqmm*	Per No.	
H 2.4.1.5	*1 x 95 to 1 x 150 Sqmm*	Per No.	
H 2.4.1.6	*1 x 185 Sqmm*	Per No.	
H 2.4.1.7	*1 x 400 to 1 x 500 Sqmm*	Per No.	
H 2.4.1.8	*1 x 630 Sqmm*	Per No.	
H 2.4.2.1	2 x 70 sq mm	Per No.	
H 2.4.2.2	2 x 2.5 sqmm (CU)	Per No.	
H 2.4.2.3	3 x 2.5 sqmm (CU)	Per No.	
H 2.4.2.4	4 x 2.5 sqmm(CU)	Per No.	
H 2.4.2.5	3 x 4 to 3 x 6 Sqmm	Per No.	
H 2.4.2.6	3 x 10 to 3 x 16 Sqmm	Per No.	
H 2.4.2.7	3 x 25 to 3 x 35 Sqmm	Per No.	
H 2.4.2.8	3 x 50 to 3 x 70 Sqmm	Per No.	
H 2.4.2.9	3 x 95 to 3 x 120 Sqmm	Per No.	
H 2.4.2.10	3 x 150 to 3 x 185 Sqmm	Per No.	
H 2.4.2.11	3 x 240 to 3 x 400 Sqmm	Per No.	
H2.4.3.1	3.5 x 10 to 3.5 x 16 Sqmm	Per No.	
H 2.4.3.2	3.5 x 25 to 3.5 x 35 Sqmm	Per No.	
H 2.4.3.3	3.5 x 50 to 3.5 x 70 Sqmm	Per No.	
H 2.4.3.4	3.5 x 95 to 3.5 x 185 Sqmm	Per No.	
H 2.4.3.5	3.5 x 300 sqmm	Per No.	
H2.5.0	**SUPPLY of CABLE LUGS for Al cables**	Per No.	
H 2.5.1.1	*4 Sq. mm to 6 sq. mm*	Per No.	

H 2.5.1.2	*10 Sq. mm to 16 sq. mm*	Per No.	
H 2.5.1.3	*25 Sq. mm to 35 Sq. mm*	Per No.	
H 2.5.1.4	*50 Sq. mm to 70 Sq. mm*	Per No.	
H 2.5.1.5	*95 Sq. mm to 120 Sq. mm*	Per No.	
H 2.5.1.6	*150 Sq. mm to 185 Sq. mm*	Per No.	
H 2.5.1.7	*240 Sq. mm*	Per No.	
H 2.5.1.8	*300 sq. mm*	Per No.	
H 2.5.1.9	*400 Sq. mm*	Per No.	
H 2.5.1.10	*500 Sq. mm*	Per No.	
H 2.5.1.11	*630 Sqmm*	Per No.	
H 2.5.1.12	2.5 sqmm (Cu)	Per No.	

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